



# Different by Design



**FORD PARTNERSHIP  
FOR ADVANCED STUDIES**

*High Standards for High Achievement*



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## Ford Partnership for Advanced Studies (Ford PAS)

# Designing for Tomorrow

Why are products designed the way they are? How do the people who invent or design products come up with ideas and develop their designs? How do they balance the needs and wishes of consumers with the realities of doing business? How can innovations in energy conversion technology be used to meet future energy needs, given social, ecological, and financial concerns?

In *Designing for Tomorrow*, you'll learn the process of product design and explore key design issues of the 21st century. You'll begin in *Reverse Engineering* with the challenge of reverse engineering: you'll analyze products from the perspectives of consumers and manufacturers. In *Different by Design*, you'll experience the design process yourselves, redesigning an existing product in order to meet specific needs or goals. Finally, in *Energy for the Future*, you'll explore innovative technologies that may transform energy use in this century.

### Module 10

Reverse Engineering

### Module 11

Different by Design

### Module 12

Energy for the Future







## MODULE 11:

### Different By Design

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# Module Overview

Have you ever seen an innovative new product and thought, “How do people come up with these things?” or said to yourself, “Why didn’t I think of that?” In most cases, the people who invent or design products don’t just wake up in the morning with a great idea for a product. These product designers work hard to develop their designs. They research customers’ needs and current products, and try to envision potential needs that customers might not be aware of themselves.

In *Different by Design*, you’ll experience the product design process firsthand. You’ll redesign a product based on information you gather from peers, market research, and your own personal experience with the product. Using the same process a product designer uses, you’ll redesign a product in a way that directly addresses customers’ needs. You’ll take into consideration such factors as cost, competition, and the development of a unique design. Once you’ve redesigned your product, you’ll prepare to introduce it to a variety of audiences.

Throughout this module, you’ll analyze and compare some existing products. For example, have you ever noticed that light switches—whose only function is to turn lights on or off—come in a variety of forms, from levers to buttons to knobs? Is there a clear reason for these differences in design? Is any one of these switches better from the user’s standpoint? You’ll also consider products that designers have made expressly for the purpose of being different, either by giving the product a distinct appearance or by adding features that competitors don’t offer. By the end of this module, you’ll understand what goes into the design of new products, and have a good sense of what it’s like to work in design professions.





# ACTIVITY 1:

## The Market Decides

### INTRODUCTION

What makes a product successful? Who decides? Thousands of new products are introduced every year. Some sell fairly well, others don't find a market and disappear without a trace, and a few become extremely popular, generating large profits for the companies that design and produce them. Why do some products succeed and others fail? In this activity, you'll learn about some of the characteristics that define successful products and explore the role that customers play in the design of these products. You'll also learn how to incorporate customer feedback into the product design process, and you'll begin a project to redesign a product yourself.

### Learning Goals

- › Determine the aspects of a product's design that are important to consumers, producers, and other stakeholder groups.
- › Analyze customer feedback to determine product features.
- › Apply appropriate techniques for idea generation in a team.

### FOR YOUR GLOSSARY

**Customer needs**  
**Focus group**

**Product need statements**  
**Qualitative**

**Quantitative**  
**Universal design**

## A DESIGN CHALLENGE

Are there any products that you use in your daily life that have features that really annoy you? Do you think that you could develop a better design? Here's your chance!

Think about some products that you use every day, and choose one that you think could be improved in some way. First, describe the aspects of the product that bother you: Are the buttons on your cell phone hard to press? Is your backpack always falling off your shoulders? Once you've identified the product's problems, develop a new design that reduces or eliminates these problems—for example, a cell phone with larger buttons. Be as inventive as you like, but try to think about the consequences of your new design. Will bigger buttons mean that you have to design a bigger phone? Will customers accept bigger phones if the buttons are easier to push? Ask yourself the following questions:

- What factors may have led to the design flaws in the original product?
- Do you think that your new design addresses those flaws?
- Would you rather use the redesigned product or the original one? Why?

## WHO DEFINES SUCCESS?

When a new product is introduced to the marketplace, there are a number of stakeholder groups (in addition to the company that makes the product) that have opinions about the success or failure of the product design:

- **Customers:** The people who purchase and use the product can share opinions about it through word of mouth or the Internet.
- **Product reviewers:** Reviews from people who have some professional expertise in a certain product area, such as automobiles or consumer electronics, may influence customers' purchasing decisions.
- **Industry associations:** Design, engineering, and manufacturing associations judge products and give awards to the best designs. These awards can bring prestige to the manufacturer and may influence sales.

Use the links provided on the **Ford PAS Web site** and work as part of a Product Review team to research one commercial product, using several different product review sites.

You need to choose a product for which you can find reviews from customers and at least one other stakeholder group. Begin by selecting one or two products with professional



product reviews or industry association awards. Then look for customer reviews, and choose the product that has a number of customer reviews available. You may have the best luck with consumer electronics (such as computers and DVD players), household items (such as blenders and small electrical appliances), or cars.

Locate and read as many reviews of the product as you can find—though, if many customers have reviewed it, you may want to read only 10 to 15 of these reviews. In addition, try to get the manufacturer’s perspective by visiting the company’s Web site and looking for product information. Then answer the following questions and give examples to support your answers:

1. What was the opinion of each stakeholder group about this product’s design?
2. Did the groups agree regarding the product’s success? Why or why not?
3. Did the different groups have different criteria for success? How do you know?
4. If this product was based on a previous design, did the changes make it more or less successful in the various reviewers’ eyes?
5. Based on the reviews of this product, would you want to own one? Why or why not?

## HOMEWORK 1.1

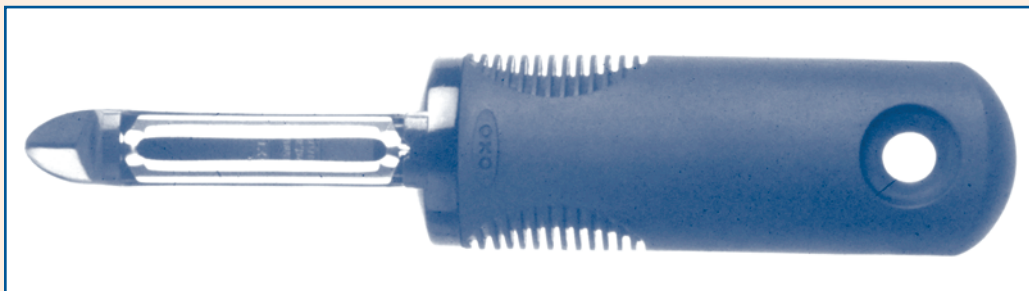
Read **The OXO Product Design Process** and answer the **Questions for Reflection**.

# The OXO Product Design Process

## Identifying the Need

When Sam Farber started OXO International in 1989, he knew he could count on at least one thankful customer—his wife, Betsey, who suffered from arthritis in her hands. Her difficulties and his own personal frustration with kitchen gadgets convinced him that **customer needs**—the specific desires of a product’s user—weren’t being met. Too many products didn’t have the features and capabilities that users like himself and, especially, his wife required. He asked himself, “Why do ordinary kitchen tools hurt your hands with their painful scissor loops, rusty metal peelers, and hard, skinny handles? Why can’t there be wonderfully comfortable tools that are easy to use?”

Farber approached a New York-based industrial design firm and asked the firm to develop a line of ergonomic kitchen tools. The firm’s assignment was to develop tools that were comfortable to hold, dishwasher-safe, high quality, good looking, and affordable. The product also had to have a **universal design**—a design that would work for as many people as possible, whatever their physical limitations. As Farber explains, “Why shouldn’t everyone who cooks have comfortable tools?”



The design team began with field research. Team members talked to consumers, examined and used competitive products, interviewed chefs, and spent hours with volunteers from an arthritis support group. They researched the range of physical limitations, from serious permanent disabilities to the limited mobility and declining strength associated with aging. They also noted kitchen gadgets that didn’t function properly and those with rusting metal, cracking plastic, and dull blades.

## Creating the Redesign

The designers divided tool types by wrist and hand motions: twist/turn (used to scoop, stir, and peel), push/pull (graters and knives), and squeeze (scissors, garlic presses, and can openers). They created hundreds of models for testing, and determined that most tools required a combination of these motions. The project narrowed to three groups: gadgets and utensils with a multipurpose handle, squeeze tools, and measuring devices.



For products with handles, the handles had to be large enough to avoid hand strain. They had to be oval to keep them from rotating in the hand. The short round ends had to fit comfortably in the palm and evenly distribute pressure during use. They had to have an oversized, tapered hole so that they could be hung easily for storage, even for those with shaky hands or weak eyes.

“We wanted the material to be soft and flexible, but it had to be easy to mold and dishwasher-safe,” Farber says. The answer was Santoprene, a synthetic rubber-like material used for dishwasher gaskets. This material not only provided a warm, non-slip handle, it could also be made with flexible fins that bend to an individual finger grip, giving the user more cushion and control, even when hands are wet and soapy. (OXO now holds a patent on this design.)

## The Importance of Design

The company could have completely covered up the fins and just made a softer, spongy area in the handle, but Farber reasoned that when people looked at the fins, they would immediately know what the company’s design was all about—it would register that this was a better grip and a better product.

Farber appreciates the importance of involving the designer in every aspect of manufacturing. “It’s essential that the designer be familiar with the factories that are going to produce the designs,” he says. “[Designers] must be aware of their production capabilities—what they can and cannot do.” OXO’s products include a line of gardening hand tools, and part of the proceeds from each sale goes to preserving the environment.

Environmental considerations also play a role in OXO’s designs. For example, OXO’s product packaging uses less plastic than its competitors. Farber explains, “Extending the life of products is ecological. Good quality and good design and universal design, when done right, are ecological. If you make a product that lasts a long time, you are reducing the amount of junk that gets thrown into the environment. As someone once said, ‘We are all only temporarily able.’ So we should use design to extend the useful life of both the object and the user.”

Go to the **Ford PAS Web site** to view some of the designs developed by OXO.



## Keeping Customers Coming Back

OXO developed a three-year marketing plan, with the initial merchandise slated for upscale distribution outlets, followed later by lower-priced lines, Softworks™ and Basics, geared to mass merchants and supermarkets. The strategy behind this plan was to make less-expensive versions of the company’s products before a competitor did and, at the same time, provide budget-conscious consumers with tools that adhered to OXO’s principles of universal design.

Farber believes that customers are loyal to an innovative company and has kept the product pipeline filled with new offerings. Another benefit, he says, is that while a competitor can knock off a single product, it's harder to knock off a broad product line. This keeps customers coming back to OXO.

## A Recipe for Success

Since the company's first products debuted in 1990, OXO has introduced nearly a hundred products. The design of OXO's products has won both customer approval and critical acclaim, garnering almost every major design prize. OXO products have been chosen for the permanent collections of several museums.

The company's financial success is equally impressive. OXO made a profit during its first full year, with more than \$3 million in sales in 1991. Its sales have increased by 50 percent each year since. Although OXO now has a broad base of products in the marketplace, it still devotes at least 10 percent of its annual revenues to ongoing design efforts—an indication of just how important design is to OXO. Marketing savvy and understanding of the consumers' needs are key to OXO's success, Farber acknowledges, "but user-centered design is our main competitive advantage."

Adapted from "Getting a Grip on Kitchen Tools," *@issue: The Journal of Business & Design*.

## Questions for Reflection

1. What steps did Sam Farber take to develop and produce his product?
2. What aspects of OXO's product design process contributed to the company's success?
3. Why do you think more products aren't designed to be accessible for people with disabilities or other physical limitations?
4. Can you think of other companies that have successfully developed products for both upscale and lower-priced markets?

# PRODUCT REVIEW RESEARCH

Complete the product review research for the product that your Product Review team chose.  
Prepare to present your findings to the class.

## HOMEWORK 1.2

Read the [Redesign Proposal Guidelines](#).

# Redesign Proposal Guidelines



In an ongoing assignment for this module, the Redesign Proposal project, you'll have an opportunity to think creatively about how you might improve a familiar product. You'll work as part of a Redesign team and use the same seven-step process that product designers use to identify a design opportunity, create a product concept that will be appealing to customers, and prepare a proposal that will interest different audiences.

## Step 1: Choose a Product and Design Approach

You can choose almost any product that you have some familiarity with—just don't choose a product that is very complex and made up of a lot of parts, such as a computer or car. Think about specific aspects of the product that you might change. (However, if these aspects rely heavily on electronic or mechanical parts, don't select this product unless one or more people on your team are very familiar with these kinds of parts.)

Products that your team might consider include the following:

- Tools
- Luggage
- Audio or electronic products
- Clothing
- School supplies
- Toys and games

Select one of the following three redesign options for your product:

1. Increase its safety for users.
2. Increase accessibility for users with disabilities.
3. Improve its performance based on your personal experiences with the product. (Do you or a friend use a product with an obvious design problem? Can you correct it?)

## Step 2: Keep a Design Log

An important part of the product design process is documentation. In order to qualify for a patent or prove that they have created an original design idea, designers have to demonstrate the progression of the design process. The best way to do this is to keep a detailed logbook, called a "design log." A design log will help you keep track of all your ideas for improving the product, and is a great place to keep sketches of potential designs, which you can use as the basis for the technical drawings of your product that you'll do in Activity 5. In addition to your product redesign concepts, your log should include information about how your team completed each of the steps in the design process.

These are the basic requirements for your design log:

- Choose a notebook with a sewn binding like that of a composition notebook. (Unlike loose-leaf or spiral-bound notebooks, notebooks with sewn bindings show that no pages have been added or removed.)
- Consider a notebook made of graph paper (called quad-ruled paper), which makes sketching easier. (While this is recommended, it is not required.)
- Number the pages of your notebook.
- Reserve the first few pages for a Table of Contents, and add listings as you make log entries.
- Write notebook entries in blue or black ink, not pencil.
- Date each entry.

Your design log must include the following:

- A description of how you collected customer feedback
- The product need statement chart that resulted from the customer feedback
- A list of all the product concepts your team generates
- A benchmarking table showing details of potential competitors' products
- A decision matrix used to choose the most promising concept, including an explanation of the results
- Minutes from meetings your team holds

### Step 3: Consider Customer Needs

Once you've chosen your product, you'll need feedback from people who use it. Identify 5 to 10 users you are targeting that your team can interview about their experiences with the product. For example, if you are improving the product's accessibility, you should get feedback from people with disabilities or the elderly, whom you might find in a senior center, nursing home, community center, or assisted-living center. You can interview each user separately or bring together a focus group to discuss the product. In either case, you'll first need to develop a series of 8 to 10 interview questions to ask.

### Step 4: Develop and Choose a Concept

Based on the feedback your team gathers, you'll develop several models or "concepts" for your redesigned product. These concepts will be based directly on the customer needs you've identified. Then, by ranking the concepts and scoring each model, your team will choose one concept to develop.

### Step 5: Incorporate Industrial Design

Once you have a good product concept, you'll need to make sure that it will appeal to customers. You'll do this by applying the principles of industrial design—developing a pleasing look and feel for your target audience. You'll also make sure that the product is easy for customers to use and maintain. After deciding on an industrial design for the product, you'll make sketches of your redesign.

## Step 6: Create Visual Models for Different Audiences

You've got a great product concept—now, how will you highlight its features for a potential customer? How can you share your design concept with a product engineer to see if it can actually be produced? Once you have determined your product's features and design, you'll create visual representations of the product to share with potential customers, manufacturing engineers, or design colleagues. To introduce your product to potential customers, your team will develop a print ad that highlights the features of the product. To convey more specific information, your team will develop a drawing that accurately portrays the product's physical characteristics.

## Step 7: Present Your Redesign Proposal

Your team's presentation should be no longer than five minutes and must include the following:

- An explanation of why you chose your product and a description of the problems with the product that needed to be addressed
- Information about how you collected customer feedback and used it in your redesign
- A detailed description of the product redesign concept, including how it meets customer needs and is likely to succeed in the marketplace
- Sketches of the product's exterior, which incorporates the principles of good industrial design
- A print ad showing your product in use, designed to appeal to the target audience
- A technical drawing or illustration of your product that adheres to the principles of technical drawing and illustration
- An explanation of how your redesigned product improved the original design

## PRODUCT REVIEW PRESENTATION

Present your product review findings to the class. As you listen to the other Product Review teams' findings, think about the following questions:

1. What features determine the success of a product for each of the stakeholder groups?
2. Are there any features that are considered important by all of the groups?
3. What do you think are the critical factors that a product design team needs to consider as it designs a new product?

## PROPOSING A REDESIGN



Review the **Redesign Proposal Guidelines** on pages 9–11 and look over the **Redesign Proposal Assessment** with your Redesign team. Generate a list of products that you are interested in redesigning.



## INTERVIEW WITH A LANDSCAPE ARCHITECT

**What is an ordinary day at work like?** What do you do? I'm a Landscape Architecture Project Manager. On an ordinary day, I have meetings with clients, coordinate work with architects, review project schedules and budgets, and manage staff.

**What do you like about your work?** What interests you or makes you feel good about your work? I enjoy creating whole environments. I work with architects to develop ideas and plans for new developments from the ground up. Our clients come to us with an empty piece of land, and we decide what it will look like in the future. Although we control the development of land, we're responsible for designing in an environmentally sound way.

**What do you dislike about your work?** The cranky clients. If you're not careful, you can have clients who are not enjoyable to work with because they have different values, ethics, or design criteria. Our goal is to be profitable enough to choose our clients.

**How did you get into this occupation?** I babysat for a landscape designer who worked out of her home. I was fascinated by the drawings in her office. In high school, I volunteered in her office sorting slides and taking notes in client meetings. After college and graduate school, I interviewed at my current firm, supported by my resume and a portfolio of my work. I was hired two weeks later. I've since been promoted twice.

**What classes or projects could high school students get involved in to prepare for this occupation?**

Volunteer at an arboretum or public garden, intern with local design companies or your city's Landscape Architecture Department, attend summer programs for secondary students interested in learning about the design professions, and volunteer with city gardening groups.

**How did you prepare for this occupation?** I worked with a landscape designer in high school and majored in landscape architecture in college. After working at landscape architecture firms in college, I attended graduate school and received a master's degree in landscape architecture. Then I worked and interned at design firms.

**What is the most relevant college major or course of study for this occupation?** Landscape architecture, architecture, city or regional planning, urban design, art, art history, or art theory.

**What is the most valuable thing you learned during your training and licensing?** That you're always learning, no matter how advanced you are in a profession.

**What skills, abilities, and personal characteristics are necessary for this career?** An inclination to draw, sketch, and look at the world around you is a must. Competence in math, natural science, and writing is also necessary. Professionalism, courteousness, and an understanding of human nature make you a desirable candidate for any job.

**Would you recommend that people enter this occupation? Why or why not?** Absolutely. It's rewarding to see something built that you designed. It's fascinating to see how structures are put together, nail by nail.

### HOMEWORK 1.3

Think of a time when you wanted to purchase a product and had to decide between two similar versions. Write a paragraph describing how you chose between the two. What factors (besides price) influenced your decision? Why did one design seem better than the other? After you purchased the product, were you happy with your choice? Why or why not?

## LISTENING TO CUSTOMER NEEDS

Listening to customers and watching them use products can help product designers see problems with existing products and inspire them to generate new designs. That is why, when ABC's *Nightline* challenged the design company IDEO to redesign a shopping cart in five days, a team from the design company headed straight for a grocery store. By observing customers using shopping carts, IDEO team members saw many flaws in the popular "wire cage" cart design. (Their new design included a child seat with a swing-up tray for a play surface, a secure spot for a cup of coffee, and steerable back wheels.) Observation was vital to the team's redesign process.

Product designers incorporate the voice of the customer into their designs in a number of ways:

- Interviewing individual customers face to face
- Bringing together groups of product users to discuss their experiences with the product
- Conducting user surveys
- Observing customers using the product

Designers can use the customer feedback they collect to understand what the customer needs and to determine what features to include in a product.

Work as part of a Product Need team and, using the guidelines in **Product Need Statements** on pages 18–19, create descriptions of the features and capabilities that a new product would need to have in order to address your **Customer Comments**. At this point, your focus should be on *what* the product needs to do, rather than *how* the product will do it.

You probably won't be able to address every need that customers have expressed. If a product were designed to meet every need of every customer who used it, it would be so complex and cumbersome that no one would want to use it at all! Look at the need statements you've created and, based on your experience with the product or what you know about the users of the product, decide which of these needs the product should meet. Organize your need statements by creating a table similar to **Table 1.1**.

**Table 1.1: Prioritized Product Need Statement Table for Backpack**

Product need statements	Should product address this need?
The backpack can hold several large textbooks.	Yes
The backpack can hold four changes of clothing and two pairs of shoes.	No
The backpack can keep both small and large objects organized.	Yes
The backpack has a space to hold a sandwich and protect it from damage.	No
The backpack has a space for cell phones and personal digital assistants.	Yes

Share your table of need statements with another Product Need team. Explain why you think the product should or should not address each product need statement. Give feedback using the **Need Statement Table Peer Assessment**.

## HOMEWORK 1.4



Consider various products and the three product redesign options for your Redesign Proposal project. Which one interests you most? Make a list of ideas to share with your team.

Read **The Art of Idea Generation** on page 20. Suggestion 7 is to use props to facilitate idea generation—are there any props you can bring in to class that will help your team generate some new ideas?

# Product Need Statements

## Using Customer Feedback

Customer feedback is a great way to learn about a product. However, the information a customer provides might not point directly to what a customer needs in a product. Sound confusing? Consider the example of a school backpack-manufacturing company that asked for feedback from its customers. The company received the following comments:

- “I like the large space and number of books that the bag holds, but my calculator is hard to find at the bottom of the pack.”
- “My lunch gets squished.”
- “Every time it rains, my books get wet.”
- “It’s great! I use it on my bike ride to and from school every day.”



These comments do not actually describe the features that a customer wants or needs. They do tell you a lot about how the customer uses the backpack. Part of a designer’s job is to use such comments to create features in the product—in this case, a backpack—that meet customers’ needs.

## Creating Product Need Statements

How do you make good use of customers’ comments? How can you interpret this information to design a better product? In *Product Design and Development*,<sup>1</sup> authors Karl Ulrich and Steven Eppinger encourage designers to take customer comments and turn them into product need statements.

**Product need statements** describe features and capabilities that a new product will have. These statements are expressed in the present tense, to help developers and others understand exactly what the product will do. For example, the customer statement “Every time it rains, my books get wet” could be translated into the following product need statement: “The backpack keeps books dry in rainy and wet conditions.”

This product need statement does not say exactly what the water-resistant material will be or how it will work. As a designer, all you know is that your task is to make a backpack that keeps the things it’s carrying dry. This is a customer need. You have the freedom to decide how you will meet this need.

The following table illustrates how customer comments can be translated into product need statements. The second column contains need statements that could be improved by following the guidelines in the third column. The need statements you develop should most closely resemble those in the fourth column, which follow the guidelines.

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<sup>1</sup> © 2000 The McGraw-Hill Companies, Inc.

Customer Comment	Product Need Statement	Guideline	Better Product Need Statement
"I like the large space and number of books that the bag holds, but my calculator is hard to find at the bottom of the pack."	The backpack has two small interior pockets, along with a narrow section for files.	Tell what the product will do, not how it will do it.	The backpack keeps both small and large objects organized.
"My lunch gets squished."	The backpack has a space for fragile items.	Be specific.	The backpack has a space to hold a sandwich and protect it from damage.
"Every time it rains, my books get wet."	Items inside the backpack will not get wet.	Be positive rather than negative.	The backpack keeps its contents dry.

# The Art of Idea Generation

When you're working as a team to solve a problem or come up with a new idea, how do you build creative energy and get everyone to contribute? In order to be productive in a session of idea generation, follow these ground rules:



1. **Assign roles.** As with any other well-run meeting, it's important that each person take on a particular role. One person should act as the facilitator—structuring the meeting, encouraging people to speak, making sure that everyone's voice is heard, and keeping the team on task. One person should act as a recorder—taking notes on everyone's ideas and keeping them organized. The rest of the team members should be active contributors—generating and responding to ideas, and taking turns so that all team members have a chance to share their input. Rotate these roles at each meeting.
2. **Set a topic and stick to it.** When you create an agenda for the meeting, decide on a topic. Try to be more specific than, for example, "Come up with products to redesign." Instead, you might say, "Develop a list of products that need to be redesigned to improve their accessibility."
3. **Set a time limit.** This will help your team stay focused on the task at hand and keep team members from feeling burned out.
4. **Give people time to think.** Some people may be more creative if they have some time to think, jot down their ideas, and/or talk to another person before they take part in generating ideas with the team.
5. **Don't criticize or dismiss ideas.** The point of this idea-generation session is to develop as many ideas as possible—nothing is too silly! If you criticize ideas, team members may be less likely to contribute—and you never know what's going to inspire a great new design.
6. **Don't discuss.** Idea generation is about soliciting as many ideas as possible. If you start discussing a suggestion, you stop coming up with new ideas!
7. **When appropriate, bring props.** Sometimes it's nice to have something to look at and play with while you're trying to generate new ideas. If you're thinking about redesigning a product, you might bring in different versions of that product to inspire you.
8. **Record every idea.** Because you may not remember everything that was said once the session is over, the recorder should make note of each idea as it is mentioned. This frees up other team members to focus on idea generation.

## CHOOSING A PRODUCT



Meet with your Redesign team to determine which of the three redesign options you will choose, and generate a list of possible products you might redesign. Use the guidelines in **The Art of Idea Generation** to structure your meeting. Once you have a list of products, discuss the merits and drawbacks of redesigning each product, considering the following questions:

1. Am I familiar with this product? Do I use it or know people who do?
2. Will I have access to a group of users that I can interview about their experiences with the product?
3. Is this product something that interests me and that I'd like to learn more about?
4. Are there likely to be several redesign possibilities for this product?
5. Can I redesign aspects of this product without needing to have a large amount of technical knowledge?
6. If this product requires technical knowledge to redesign, does anyone on my team possess this knowledge?

Use your answers to these questions to help you choose a product for your team's Redesign Proposal project.

### HOMEWORK 1.5

Read **Getting Customer Feedback**.





# Getting Customer Feedback

Gathering customer feedback is an important step in the product design process. Without customer input, you may create a beautifully designed product that no one wants to buy! Here are some strategies for getting customer feedback.

## Decide How to Collect Feedback<sup>2</sup>

There are several different ways to collect feedback from customers:

- **Interview customers individually:** Ask customers a series of questions about their use of the product. It's best to conduct the interview in the customer's environment, but interviews can also be done over the phone or via e-mail. Interviews have the advantage of giving you one-on-one contact with the customer. They can, however, be time consuming, lasting anywhere from a few minutes to a couple of hours.
- **Observe customers' use:** Watch customers using the product as they normally would in the environment in which they usually use it. Observation can be a great way to notice problems with the product (or unusual uses for it) that customers may not think to mention when being interviewed. This technique can be combined with interviewing customers individually.
- **Conduct a focus group:** In a **focus group**, a number of customers (usually 8–12) are brought together to discuss their experiences with the product. A member of the product design team usually moderates the focus group. Focus groups have the advantage of bringing together a variety of viewpoints and can take less time than individual interviews. However, some customers may not feel free to express their opinions in a group setting.
- **Survey customers:** Send paper or electronic surveys to customers to fill out and return. This method can be very convenient, but it usually provides less information than the other methods, and doesn't give members of the product design team an opportunity to interact with customers and follow up on their answers to questions.

## Choose Customers to Observe or Interview

Once you have decided how you will collect information, you need to select the customers you want to interview. Obviously, customers should be familiar with the product. There are several different types of people who might use the product, depending on the situation:

- **Occasional users:** Customers who use the product infrequently, perhaps a few times a month
- **Frequent users:** Customers who are more familiar with the product, perhaps using it several times a week
- **Heavy users:** Customers who use the product almost daily, often for work, school, or a serious hobby

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<sup>2</sup> Adapted from *Product Design and Development* by K. T. Ulrich and S. D. Eppinger © 2000 The McGraw-Hill Companies, Inc.

While it's a good idea to interview customers from each category, make sure that you observe and interview heavy users of the product. They often have a better sense of the product's uses and limitations and are more able to clearly articulate what they need from the product.

## Decide What to Ask the Customer

If your goal is to redesign a product, what types of questions will give you information you can use?

The following list<sup>3</sup> suggests the types of questions that a design team might ask about a product:

- When and why do you use this type of product?
- How do you typically use the product?
- What do you like about this product?
- What do you dislike about this product?
- What features do you consider when purchasing this type of product?
- What improvements would you make to this product?

Notice that the questions mentioned above are **qualitative** rather than **quantitative** in nature—that is, they ask for a descriptive analysis of the product, rather than a numerical rating (rating a specific feature of a product on a scale from 1 to 5, for example). Qualitative questions help designers learn how customers use the products and can sometimes uncover new and unusual uses that the product developers never intended. In his book *The Art of Innovation*, author Tom Kelley calls these innovative users “rule breakers.” Often, Kelley writes, new product ideas develop from “the woman who takes a shortcut, who forces the product to do something the manual says it can’t, who imagines what it might do if only . . .” Gaining information about how the product is actually used is very important to successful product design.

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<sup>3</sup> From *Product Design and Development* by K. T. Ulrich and S. D. Eppinger © 2000 The McGraw-Hill Companies, Inc.

## ASKING THE RIGHT QUESTIONS

Using **Getting Customer Feedback** on pages 22–23, identify some potential customers to interview about your product, then develop a list of questions to ask these customers and a plan for contacting and interviewing them.

## PLAN YOUR REDESIGN TASKS

One of the most important steps that a design team must take at the beginning of the product design process is to develop a timeline for the project. In order to complete a successful



Redesign Proposal project, you'll need to do the same thing.

Using the **Redesign Proposal Guidelines** on pages 9–11, make a list of all the tasks you'll need to complete for your project, assigning each team member responsibility for one or more tasks. Then develop a PERT chart that shows the order in which these tasks must be completed and the date by which they need to be completed. To help keep your work on schedule, your team should refer to this chart frequently throughout the product redesign process, updating it as necessary.

### HOMEWORK 1.6

Conduct a “study of the mundane” by looking closely at two things in your home that are used to perform common, simple, yet important tasks. Here are some items you might choose:

- Faucets
- Chairs
- Trash cans
- Shampoo bottles
- Toothbrushes (even just toothbrush handles)
- Doorknobs

Do the following for each item:

1. State the need the item meets for the user.
2. Describe how the item operates. For example, “The doorknob is grasped in one hand and turned clockwise to open the door.”
3. Sketch the appearance of the item.

## EXTENSIONS

### 1.1

Go to the **Ford PAS Web site** and follow the link to IDEO's Web site. Create a poster showing the IDEO shopping cart design, as well as the key design considerations that IDEO staff tried to address, the features of IDEO's new shopping cart, and how these features were meant to address the various design considerations.



### 1.2

Read **Harley-Davidson—A Unique Approach to Customer Relations** on the **Ford PAS Web site**.

How does Harley-Davidson get information about its customers and their needs? Consider the potential benefits and drawbacks of this type of information-gathering. Then create a presentation for the chair and the board of directors of the company explaining why you do or don't support the company's methods of interacting with its customers.



### 1.3

Use a computer-aided design (CAD) program to draw two versions of a mundane object for two specific user groups.



## ACTIVITY 2:

# From Need to Concept

### INTRODUCTION

Once product designers know what the market wants, how do they create a new product? First, they need to study competitive products—they compare and contrast similar products that accomplish identical tasks or meet the same needs. Often they use “benchmarking,” a systematic comparison of competitive products. In this activity, you’ll learn about benchmarking and about using customer feedback to generate product ideas that incorporate the features that directly satisfy your customers’ needs. As part of your ongoing Redesign Proposal project, you’ll apply these methods of benchmarking and idea generation to redesign your team’s product.

### Learning Goals

- › Given a set of product needs, generate several design concepts for a product.
- › Survey competitive products to analyze their features.

#### FOR YOUR GLOSSARY

**Benchmarking**

**Product concept**

## A STUDY OF THE MUNDANE

Would you rather turn a knob or push a handle to open a door? Do you prefer a single lever in the middle or handles on either side of the sink faucet? Is it easier to use a dial or a slider to change the volume on your stereo? There are so many different ways to complete very simple tasks—why do we have all these choices?

Share information about the two items you chose for your “study of the mundane” with your classmates, and answer the following questions for each item:

1. Why do you think the object is designed the way it is?
2. Does the design of the object reflect any need the user has? For example, a person drinking coffee from a mug needs to have a handle to keep from getting burned by the hot mug. A person turning on and off the water faucet needs a handle that can be gripped with wet hands.
3. Are there elements of the product’s design, such as its appearance, that are not essential to the product’s operation? Do these elements hurt or improve the product’s performance in any way?

Were the items you studied for homework similar to or different from those studied by your classmates? How similar or different were they?

### HOMEWORK 2.1

Find as many timepieces as you can in your home. Make note of their locations and differences in design. Why do you think the manufacturers chose different designs for comparable models? Do the differing product features meet different needs or the same need? Do some of the products work better than others? Why?

## KNOWING THE COMPETITION

As a product designer, you want to know how your product stacks up against the competition. How can you be sure that you're really creating something new that offers customers an attractive alternative to competitors' products?

One major component of design is **benchmarking**, a process that product designers use to analyze and compare details of different brands and models of the same type of product. With benchmarking, you only focus on the physical properties of the product—you don't rate the product itself. In general, benchmarking does the following:

- Provides an objective look at similar products in the same price range that are manufactured by different companies
- Compares features and functions that similar products offer
- Helps you determine target specifications for a new product

Suppose that you are going to design a sports watch—specifically, a dive watch (a watch for underwater divers). You learn from customers who have purchased dive watches that they like the feel of a heavy watch. Before you make any decisions about how heavy your new watch design will be, you should know as much as you can about the weight of the dive watch models already on the market.

In general, if you can think of a property—such as weight—that makes you want to choose a particular product over another, then that property should be benchmarked. What other properties might you benchmark to compare dive watches? For example, is your Product Need team concerned about the prices of competitors' products? If so, "price" should be a column on the benchmarking table you develop.

## MEASURING UP

If you are redesigning a product, it's important to see how the competition stacks up. Working in your Product Need team, you will benchmark your product. First decide which information you'll compare, choosing at least six different characteristics, including the product name, the materials used, and any special features, such as extra alarms. Once you have completed the benchmarking, discuss the following questions:

1. Are there characteristics that seem uniform across the different brands and models?
2. Do any of the models have unique features or characteristics? Do these models stand out as better or worse than the others?
3. If you were redesigning your product, how would you use the information in this table?

## HOMEWORK 2.2

Read [A Designer's Concept](#).



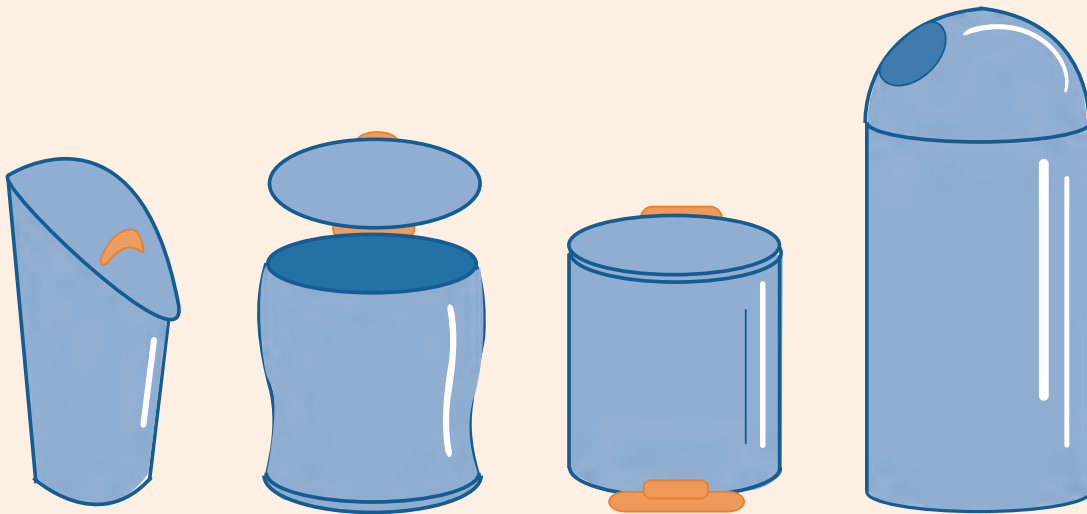
# A Designer's Concept

## What's in a Concept?

Once you know what your product needs to do, what's the next step? Now's your chance to be creative, envisioning as many different ways to meet the customers' needs as you can.

In the earliest stages of product design, an idea for a new or redesigned product is called a **product concept**. What you might think of as two different ideas for a product, a product designer would call two different concepts. As a product designer, you should think of as many different concepts as you can that will meet the customers' needs. Even when the difference between two concepts is small—one has a snap while the other has a button, for instance—each concept should be considered a different product, because a user will interact with each one differently.

Four different concepts for a new type of kitchen garbage can are shown here. Can you identify any features or options that the product design team may be exploring?



## Coming up with Concepts

How do designers develop new concepts for products? Once they have established what customers need from the product, there are several ways that designers get inspiration for new concepts. Often a design team will meet together several times to develop as many different concepts as possible—no matter how unrealistic or silly they seem! The following are some of the things that designers do when creating concepts:

- **Experiment:** Sometimes good ideas result from trying to solve a problem in innovative ways. For example, Bill Bowerman, one of the founders of Nike, invented the soles for the modern athletic shoe by putting rubber in his waffle iron!
- **Look at the natural world:** Observing and learning about the movement of animals, plants, bodies of water, and other natural phenomena can inspire new designs. For example, researchers at Northeastern University in Boston designed a robot that looks and moves like a lobster and adapts to changing underwater conditions, using techniques similar to those used by lobsters. The designers envision that the robot will collect data about oceans and rivers and help track pollution.
- **Observe human behavior:** Watching the way that people move and interact with their surroundings can also be inspiring. One day, Larry Miller happened to notice the circular pattern that his daughter's feet made as she ran. This inspired him to design the elliptical trainer, which allows feet to follow this same circular pattern without the impact of running.
- **Observe the customer:** Watching how people *actually* use products—as opposed to how designers *assume* the products will be used—can lead to improved design. For example, the designers at IDEO were designing a new toothbrush for young children. Since children's hands are smaller than adults' hands, one might assume that the handle should be smaller than the handle on an adult toothbrush as well. But after observing kids using toothbrushes, the designers realized that young children grasp the handle with their whole hand, instead of with their fingers, as adults do. In order for the toothbrush to have a good design for children, the handle actually had to be bigger than the handle on an adult toothbrush.
- **Look at existing products:** When designers work on new products, they often closely examine competitors' products. This can be a good way to look at current “state of the art” features and develop ways to improve on them.

## CREATING A CONCEPT

In Activity 1, you used customer comments about four different products—a clock radio, a TV remote, a cell phone, and a wristwatch—to generate a list of product need statements. You know what customers need from the product; now you can decide how you want the product to meet those needs. What would an easily adjustable watchband look like? How can you make the look of buttons on a cell phone match their function? Now you'll create product concepts based on customer needs.

Consider the following example: A number of product reviewers have commented that a certain clock radio manufacturer should revisit the design of its radio because it's difficult for a user to tell how high or low the volume is set without turning it on. The manufacturer might address this problem by placing an indicator on the radio's display to show the volume level, or adding a large volume-control knob with marks that identify the volume level. Either feature accomplishes what the radio needs to do—give the user an idea about how loud the volume is set without turning on the radio.



The following steps provide an organized way to generate concepts for new or redesigned products:

1. Look at your product need statements again to see what kinds of features your customers want and which needs you think should be addressed by the product.
2. Look at the benchmarking chart to see how (or whether) competitors are addressing these customer needs. Determine whether you could use or improve on any of the benchmarked products' features in your product concept.
3. Develop several product features that address each of the product needs you identified as important in Activity 1. Remember, at this point don't reject any ideas, no matter how wild they are!
4. As a team, choose several of the features you developed to include in your two final product concepts.
5. Using the features you have chosen, generate two different product concepts.

Use these steps to generate two product concepts based on your product need statements from Activity 1. For each of your two product concepts, create a poster showing the following:

- The product's name
- A sketch of the product (such as what you might see in a catalog)
- A list of the major features of the product that reflect the product need statements you generated from customer feedback

Your team will have a total of three minutes to present both of your product concepts.

Your presentation should include the following:

- Details about any unconventional features of your concepts
- A rationale for each feature
- A description of who would purchase your product (the potential market)

### HOMEWORK 2.3



Continue to work on your Redesign Proposal project, focusing on any tasks you've been assigned related to gathering information about your product from customers.

### HOMEWORK 2.4



Continue to work on the tasks you've been assigned for your Redesign Proposal project.

## CONSIDERING CUSTOMER NEEDS FOR REDESIGN



Work with your Redesign team to organize all the customer comments you've gathered for your product redesign. Then use these comments to create a comprehensive list of product need statements—being sure to eliminate any statements that may be repetitive. Once you complete the list of statements for your product, work with your team to determine which needs you think your product should address.

Review the PERT chart for your project, and assign team members responsibility for any new tasks that you've added to the chart.

### HOMEWORK 2.5



Search for products at home or on the Internet that are similar to the one your team is working on for the Redesign Proposal project. Choose at least six characteristics of these products, and benchmark them.

## REDESIGN CONCEPTS



Using the techniques described in **The Art of Idea Generation** on page 20, generate a list of potential concepts for your Redesign Proposal project by drawing on your Redesign team's list of product need statements. Remember—don't reject any ideas at this point in the development process. Be as creative as you can!

### DID YOU KNOW?

So, you have a great idea for a redesigned eraser? Do you think your idea is an original one? According to the Thomas Register of American Manufacturers, there are 18 companies in the United States alone that manufacture erasers. Most likely each offers multiple products . . . so you'll definitely need to do some benchmarking before you know whether your idea is better than the erasers already offered by competitors. Go to the **Ford PAS Web site** for a link to the Thomas Register of American Manufacturers and search the database to find out more.



### HOMEWORK 2.6

Read **Choosing a Concept**.

Complete the **Idea Generation Skills Assessment**.

# Choosing a Concept

As a member of a product design team, how do you decide which product concept to further refine and develop? Ulrich and Eppinger<sup>4</sup> recommend a number of ways, including the following:

- **External decision:** Ask customers to rate or choose your concepts.
- **Internal decision (individual):** A member of your product design team may have particular expertise or experience with the product. In this case, allow this expert to choose the concept.
- **Intuition:** Members of your design team may have personal experience with the product. Go with the concept they judge to be the best one.
- **Voting:** Vote on the best two or three concepts.
- **Pros and cons:** After considering product need statements, benchmarking tables, and other related information you have, develop an extensive list of pros and cons for each concept.
- **Prototype and test:** Build prototypes of your concepts and test each one to find out which concept is the best.
- **Decision matrices:** Create a table that rates each concept based on the selection criteria your team has generated.

Most likely, your Redesign team will use some aspects of several of the methods listed above to choose concepts to develop further. However, it's a good idea to include a more objective method, such as the decision matrix you'll learn about in Activity 3, as part of the decision-making process.

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<sup>4</sup> From *Product Design and Development* by K. T. Ulrich and S. D. Eppinger (2000, pp. 139, 142). © 2000 The McGraw-Hill Companies, Inc.

## EXTENSIONS

### 2.1

Use a CAD program to draw one or more of the different concepts you are considering for your Redesign Proposal project.

### 2.2

Pick a company and interview someone involved with new product design. Create a profile of the interviewee that does the following:

1. Identifies the person—name and company information
2. Briefly describes the role that new products play in the company's overall business strategy
3. Describes the company's process for creating new products, from research to launch—including sources of ideas, evaluation and testing procedures, and other factors that affect how the company proceeds with product design and development

### 2.3

Create a profile of one of the following designers (or find another individual to profile) to share with your class:

- Raymond Loewy
- Wendy E. Brawer
- Alvar Aalto
- Mario Bellini
- Jane Atfield

Be sure to include information about this person's training or background in design and at least one detailed example of the person's design work.





## ACTIVITY 3: Which Product Concept?

### INTRODUCTION

When designers study competitive products, how do they choose the product concepts that will best address the needs of their customers? What costs do they need to consider when selecting a concept for production? You'll learn to generate a "decision matrix"—a tool that is used to display and compare potential product concepts—in order to determine the "top" concept. You'll also study the financial aspects of product design related to development costs, production costs, and sales revenues by looking at a basic financial model for a sample design project. Finally, you'll consider a number of the basic questions that companies must take into account when choosing to invest in a new product design.

### Learning Goals

- › Analyze product concepts to identify which concepts to develop further.
- › Assess the financial outlook for a new product design, including development, production, and marketing costs.
- › Use decision-making methods to choose among several desirable options.

### FOR YOUR GLOSSARY

**Base-case model**

**Decision matrix**

## COMPARING CONCEPTS

How do product designers determine the product concepts that are most likely to meet customers' needs? Suppose you have a list of five product concepts, and your product development team can only choose one concept to develop further. How do you make your decision? Everyone on the development team helped to create the concepts, so it's likely that each person has his or her favorite. If you take a vote and choose the most popular one, will you make the best decision? If each person's vote is based only on personal preference, you won't necessarily pick the concept that meets most customers' needs.

A decision matrix can help with your selection process. A **decision matrix** is a table composed of two categories of information—product concepts and selection criteria. The selection criteria are properties or factors that influence the quality of the product and help a customer decide whether to purchase it. For example, the selection criteria for a shirt may consist of comfort, durability, and appearance. The decision matrix provides a way to score your product concepts according to the selection criteria. Once the selection criteria have been decided, each concept is scored according to those criteria. The concept with the highest score is the one that customers are most likely to prefer.

To practice making and using a decision matrix, create a matrix for headphones concepts. Look at several models of headphones and brainstorm to create a list of at least six selection criteria that you'll use to rate each concept, including both physical features, such as size, and non-physical features, such as price. For example, when purchasing headphones you might want a pair that is comfortable, has good sound quality, and isn't too big. Translate these qualities into such criteria as "comfort," "sound quality," "size," and "appearance," and create a list of these criteria. Use the following sample comments to help create your selection criteria:

- "Needs to be comfortable."
- "Sound quality must be good."
- "Can't be too heavy."
- "Don't want my ears to get hot."
- "Needs to look cool."



## HOMEWORK 3.1

Describe your personal experience with two different versions of the same product. Which product concept worked better for you? Why?

## SCORING HEADPHONES



Now that you have a decision matrix completed for headphones concepts, you need to score each concept. There are three possible ratings for each selection criterion: below average, average, or above average. Each score is assigned a numerical value, as shown in **Table 3.1**.

**Table 3.1: Scoring a Decision Matrix**

Below Average	-1
Average	0
Above Average	+1

How do you decide which rating to assign? Although scoring is not totally objective, your team should discuss the score and make a well thought-out decision.

Once you have scored each concept for the entire list of selection criteria, total the scores at the bottom of your matrix. The concept with the highest score is the one that your team has rated the “best” concept.

Did you determine the most popular concept? Go to the **Ford PAS Web site** for links to Internet sources of product ratings and check your results. Then compare your results with those of others in your class—were your results similar or different?



Think about your experience with using a decision matrix and answer the following questions:

1. Are there any aspects of the product concept that a decision matrix doesn't take into consideration?
2. Could a highly rated conceptual model become a commercial failure? Can you think of factors that might make this happen?
3. What other steps might a design team take to choose which product concept to develop?

### HOMEWORK 3.2

Read **Manny's Batting Gloves** and answer the **Questions for Reflection**.

# Manny's Batting Gloves

Manny's Baseball Supplies, a sports equipment company, is trying to expand its product line. A product development team for Manny's has developed a concept for a new batting glove. The team is excited about the prospect of creating a product based on this concept, but will the gloves make money for the company? Does the company even have the funds to support the development of this new glove? By creating a project schedule that shows how expenses and revenues will accrue, the development team can determine whether developing the product concept is a wise financial move. Manny's can also figure out whether and when it will make a profit on its investment.

First, the development team needs to consider how long it will take to develop, produce, and market the actual product. The team members have determined that they will be able to complete this process within two years.

Next, Manny's development team has to consider both its expenses and its revenues to see if and when the new gloves will make money for the company. In order to do this, the team needs to develop a **base-case model**. A base-case model, as it relates to product development, is the basic financial model that the development team uses to project revenues and losses for a specific product over the course of several quarters. The base-case model includes information, based on the development team's best research and assumptions, about the expenses and revenues associated with developing, manufacturing, and selling a new product. This information includes development costs, ramp-up costs, marketing and support costs, and production costs.

Development Team's Considerations	Manny's Development Considerations
Development costs	Expenses associated with researching, designing, and testing the new batting gloves
Ramp-up costs	Expenses for getting production of the new batting gloves started, such as new manufacturing equipment that Manny's doesn't currently own
Marketing and support costs	Expenses for introducing the new gloves to the market, such as creating a new ad campaign
Production costs	Expenses for producing the new gloves, such as the costs of raw materials and labor
Sales revenues	Estimated amount of money that Manny's can make from selling its new line of batting glove

Revenues are from projected sales of the product. Once a development team has created a base-case model, the team can modify the model to look at projections based on more optimistic or more conservative scenarios, or by including more detailed information.

**Table 3.2** shows how the expenses and revenues for a new product can be mapped out.<sup>5</sup> Each year of the project is divided into quarters (Q1, Q2, Q3, and Q4). The shaded blocks indicate when Manny's expects the costs and revenues to accrue. For example, the development phase for the new gloves will be completed by the end of the first year.

**Table 3.2: Schedule for Estimated Costs and Revenues**

	Year 1				Year 2	
	Q1	Q2	Q3	Q4	Q1	Q2
Development costs (\$)						
Ramp-up costs (\$)						
Marketing and support costs (\$)						
Production costs (\$)						
Sales revenues (\$)						

The development team's next step is to fill in the financial details. **Table 3.3** shows estimates of all the costs and revenues associated with the new batting gloves. Development costs end after the first year, by which time the glove will have been developed and the company will be getting ready to begin production. By the time the project has reached the second quarter of the second year, production will have begun. At that point, the schedule includes estimates of the following:

- Production costs
  - Production volume
  - Unit production cost (the cost of production per pair of gloves)
- Sales revenues
  - Sales volume (the number of gloves sold)
  - Unit price (the price of a pair of gloves)

<sup>5</sup> Tables 3.2 and 3.3 are adapted from *Product Design and Development* by K. T. Ulrich and S. D. Eppinger. © 2000 The McGraw-Hill Companies, Inc.

**Table 3.3: Schedule for Estimated Costs and Revenues,  
Manny's Batting Gloves**

	Year 1				Year 2	
(\$ values in thousands)	Q1	Q2	Q3	Q4	Q1	Q2
Development costs (\$)	-350	-350	-350	-350		
Ramp-up costs (\$)				-1,500	-1,500	
Marketing and support costs (\$)					-150	-150
Production costs (\$)						-1,400
Production volume						100,000
Unit production cost (\$)						-0.014
Sales revenues (\$)						2,800
Sales volume						100,000
Unit price (\$)						0.028
Quarter revenues or losses (\$)	-350	-350	-350	-1,850	-1,650	1,250

In this table, costs are shown as negative numbers, while revenues are shown as positive numbers. For example, the development team has estimated expenses of \$350,000 for each of the first three quarters of the project (Q1–Q3).

### Questions for Reflection

1. Will Manny's new product make a profit by the end of the second quarter of Year 2? Use the development team's cost and revenue estimates provided in **Table 3.3** to find the answer.
2. Compare the production volume to the sales volume. Do you think it's likely that the company will sell all the gloves it produces, as it has projected? How can Manny's ensure good sales? Explain your answer.

## IS THE CONCEPT WORTH THE COST?

How do companies decide whether new product concepts are worth producing? What would happen if a company spent a large amount of money on the design and production of a new concept, and the product was a commercial failure? After designers identify product concepts they want to develop further, they determine what the development costs, production costs, and sales revenues will be for each product concept, and take this information into account when deciding which ones to produce.

Analyze the information provided in **BestFone Case Study**. For each of the two phone options, create a costs and revenues schedule modeled on the one in **Manny's Batting Gloves** on page 44. The schedule should include information for all four quarters of Years 1 and 2.

Then, using information from the schedules and the case study, determine which new line of phones BestFone should develop and produce, and be prepared to explain why you chose this option.

### DID YOU KNOW?

Did you know that even a very accomplished inventor can have trouble making a new product succeed on the market? Dean Kamen, an extremely successful inventor of medical devices, started in the business while only in his twenties. The inventions that made Kamen's reputation met clear medical needs. However, Kamen's Segway scooter—considered to be a great invention in terms of the technology used—was in big trouble as soon as it reached the market. What happened?

The Segway started out with several strikes against it: a high price tag (around \$5,000), a weight of more than 80 pounds, and a top speed of only  $12\frac{1}{2}$  miles per hour. Its battery life was limited (it could go for 15 miles per charge, but only under "optimum" conditions—flat terrain, no wind, and at a constant speed), so it needed to be recharged often. Buyers required four hours of training to be prepared to take to the streets on the Segway, yet the product was sold over the Internet, with no provision for the necessary training. And, in a masterstroke of bad timing, the product was released at the end of 2001—just as the United States (and most of the world) was seeing the economy get worse each day. As a result, sales after the product launch were much slower than expected.



## HOMEWORK 3.3



Continue to work on the tasks you've been assigned for your Redesign Proposal project.

# BestFone Case Study

The BestFone Company has been in the mobile phone business for a number of years and has a large, loyal customer base. Although it has not released a new model in more than a year, BestFone continues to enjoy considerable success.

Over the past year, BestFone has seen many competitors enter the market, offering phones with new features—cameras, games, MP3 players, wireless Internet—that its own product line doesn't currently offer. The company's management is divided on how to handle the new competition. Some believe that the new features being offered on competitors' phones don't work very well yet and that customers will be turned off by the poor performance. Others believe that BestFone's product line will not be able to compete with the flashy new features of these phones—they are concerned that BestFone's products will be seen as old-fashioned.



In order to keep its existing customer base and attract new customers, BestFone has decided to develop a new mobile phone line. The company's product designers have offered two distinct product concepts to pursue.

## Option 1

This new product line would not be substantially different from BestFone's current line. The new phones would simply make improvements to features that are already included in BestFone's current products. This line of phones could be developed and begin being manufactured in under a year. The new phones could be sold for slightly more than BestFone's current line, and BestFone would begin to see increased profits within a short period of time. Because the changes to this phone are mostly cosmetic, it could only be sold in the marketplace for about two years before it became outdated.

## Financial Information for Option 1

Development costs (\$)	\$350,000 per quarter for the first two quarters of Year 1, and \$250,000 for the third quarter of Year 1
Ramp-up costs (\$)	\$750,000 per quarter for the third and fourth quarters of Year 1
Marketing and support costs (\$)	\$100,000 per quarter, beginning in the fourth quarter of Year 1 and continuing for all of Year 2
Production volume	200,000 phones each quarter, beginning in the fourth quarter of Year 1 and continuing for all of Year 2
Production costs (\$)	\$24 per phone beginning in the fourth quarter of Year 1 and continuing for all of Year 2
Sales volume	200,000 phones each quarter, beginning in the fourth quarter of Year 1 and continuing for all of Year 2
Sales price (\$)	\$48 per phone, beginning in the fourth quarter of Year 1 and continuing for all of Year 2

## Option 2

The second option for a new line of phones would take considerably longer to develop. Designers would develop phones that match or improve on competitors' new phones. Because this option would involve researching new technologies, the product design team estimates that it would take a year and a half to develop and begin to manufacture the new line of phones. These phones could be sold for substantially more than BestFone's current product line. However, development costs would be significant, and BestFone wouldn't be able to sell the new line for several quarters—though, because this product line would have substantial technological advancements, it could be sold in the marketplace for three to four years before becoming outdated.

## Financial Information for Option 2

Development costs (\$)	\$750,000 per quarter for all of Year 1 and the first quarter of Year 2
Ramp-up costs (\$)	\$1,250,000 per quarter for the first two quarters of Year 2
Marketing and support costs (\$)	\$225,000 per quarter beginning in the second quarter of Year 2
Production volume	200,000 phones each quarter beginning in the second quarter of Year 2
Production costs (\$)	\$41 per phone beginning in the second quarter of Year 2
Sales volume	200,000 phones each quarter beginning in the second quarter of Year 2
Sales price (\$)	\$82 per phone beginning in the second quarter of Year 2

## REDESIGN DECISION MATRIX

Build a decision matrix to score the product concepts your Redesign team has generated. Use the information you gathered about the product to help determine the selection criteria you'll use to compare the concepts. Be sure to record a copy of the decision matrix and scores in your design log. Based on the scores from your decision matrix, choose the two concepts that seem to have the most promise, and make sketches of these two concepts.

### HOMEWORK 3.4



Continue to work on your Redesign Proposal project. Think about how you can present the two concepts you've chosen to the class

## REDESIGN IN MINUTES



How well did your decision matrix work? Did your Redesign team determine the best concept to develop further? Now's your chance to share your concepts and get some feedback from your classmates.

Prepare to present the two redesign concepts you've chosen. Remember, you'll have only three minutes for your presentation. Think of the time limit as a challenge, and focus your presentation on the most important aspects of your concepts. Present the following information about each:

- The concept's name
- A simple sketch of the concept
- A list of the concept's most important or innovative features

You should also describe what you expect your customers to like about the concept and why they will choose your concept over the current competitive products on the market.

You might want to use a stopwatch when you practice your presentation to make sure that you're staying within the time limit.

Give feedback to the other Redesign teams about the product concepts they present. Use the following questions to assess each concept, based on the information the team presents:

1. Do the features and design of each concept meet the needs of potential customers?
2. Is each of the concept's features clearly distinguishable?
3. Are any of the concept's features frivolous or unnecessary? If so, do these features take away from the overall appeal of the concept?

### HOMEWORK 3.5



Continue to work on the tasks you've been assigned for your Redesign Proposal project.

## EXTENSIONS

### 3.1

Create a decision matrix for a large or complicated object, such as a television. Can you determine features that are optional? How would you use this technique to determine the best add-on features for a product?

### 3.2

Go to the **Ford PAS Web site** and read about the Segway scooter. What weaknesses, if any, were there in Dean Kamen's business plan for the Segway? If the Segway were your invention, what actions would you have taken to identify customer needs that it might meet?



### 3.3

Using a CAD program, draw the two product concepts you selected in this activity.







## ACTIVITY 4: Standing Out in the Crowd

### INTRODUCTION

In today's crowded marketplace, a product that works well and meets customer needs can still fail if it doesn't stand out from the competition. How can companies create the kinds of products that make customers think, "I've got to get one of those"? In this activity, you'll learn how product developers use industrial design to create products that customers want. You'll see some examples of different kinds of industrial design and analyze several products to determine which of their designs is most successful. You'll also get a chance to apply some industrial design techniques to your Redesign Proposal project.

### Learning Goals

- Identify and describe the successful use of industrial design techniques.
- Use industrial design techniques to create a unique identity for a product.

### FOR YOUR GLOSSARY

**Aesthetics**  
**Differentiation**

**Ergonomic design**  
**Functionality**

**Industrial design**  
**User interfaces**

# WHAT IS INDUSTRIAL DESIGN?

When you go shopping, what kinds of products catch your eye? Ones that are brightly colored, or have unique shapes, or look like they'd be fun to use? For most products you see, a group of people have thought very deliberately about how you will react to the way the product looks, how you will respond to the product when you touch it or hold it in your hand, and how you will interact with the product when you begin to use it. These people try to make sure that the product has good industrial design.

The **industrial design** of a product includes how it looks (sometimes referred to as its **aesthetics**), how it feels, and the way that customers interact with and use the product through user interfaces. **User interfaces** include any part of the product that customers touch, look at, or otherwise

make contact with as they use or operate the product. User interfaces may include such items as buttons, handles, seats, laces, screens, and keyboards. Industrial designers may also be concerned with making sure that a product is safe, has a good ergonomic design, and is easy for customers to maintain and repair.

## WHAT IS ERGONOMIC DESIGN?

An **ergonomic design** takes into consideration people's physical capabilities and limitations. Products with good ergonomic design can be used comfortably by a wide range of users. For example, an ergonomically designed desk chair could be used by someone who was five feet tall and someone who was six feet tall—without either person experiencing back strain.

It's important for most products to have a good industrial design for a variety of reasons:

- 1. Attracting customers:** Customers are often drawn to products with designs that are fashionable, dramatic, or pleasing to the eye, and are therefore more likely to purchase them.
- 2. Keeping customers:** If customers find a product easy to use and maintain, they are more likely to continue using it or to purchase the same model or a similar model from the same company.
- 3. Creating brand recognition:** Companies can use industrial design to create an image that is reflected in an entire line of products. For example, a car company may design all of its sedans with a certain unique shape. Customers can then recognize a car made by that company without needing to see the maker's logo on the car.

**4. Creating brand identity:** Companies can create a certain image for their products through industrial design. For example, if a company wants its product to be perceived as cutting-edge, it might use aerodynamic shapes and polished metal surfaces. If it wants the product to be perceived as safe or comforting, it might use softer shapes and muted colors.

What are some characteristics of good industrial design? Look at the four pairs of products in **Industrial Design Comparison** and answer the following questions for each pair:

1. Does one of these products appeal to you more than the other? If so, why?
2. What image were the industrial designers trying to create through the products' aesthetics?
3. What are the products' user interfaces?
4. How easy do you think each product would be to use?
5. What audience was each product designed for?
6. Overall, do you think one of these products has a better industrial design? If so, why?

## HOMEWORK 4.1

**Functionality** refers to a product's ability to perform its intended use or operation. Describe several products for which industrial design might be less important than functionality, and explain why.

# Industrial Design Comparison

## Scooters



**RazorXLR8R Electric Scooter**



**ZAP ZAPPY Electric Scooter**

## Razors



**BIC Classic Sensitive Shaver**



**Gillette for Women Venus**

## Athletic Shoes



**Reebok Men's Classic Cielo**

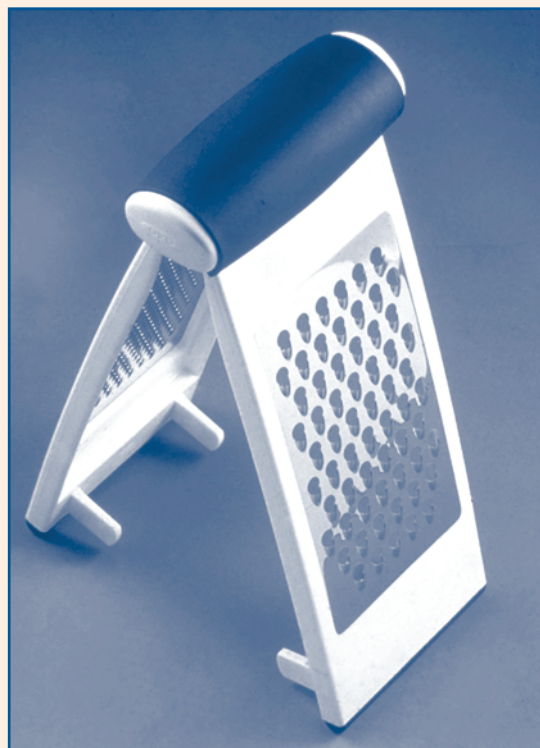


**Nike Men's Air Hyperflight**

## Cheese Graters



**IKEA Cheese Grater**



**OXO Multi-Grater**

## SEEKING GOOD DESIGN

How can you rate a product's industrial design? One way is to look at how well a product performs in each of the following categories,<sup>6</sup> which address the most important aspects of industrial design:

1. **Quality of user interfaces:** How easy is the product to use? Are the buttons or other controls easy to operate, and is it clear what each one is for? Are you able to get the product to do what you want without a struggle? Does the product seem safe? How accessible is the product for people with disabilities?
2. **Emotional appeal:** How does the product make you feel? What kind of image does it project? Is it pleasing to look at? How does it feel when you hold it in your hand? Is it something that you would use every day?
3. **Ease of maintenance and repair:** If the product has batteries, is it easy to change or recharge them? If the product were broken, would it be easy to fix?
4. **Appropriate use of resources:** Are any of the features of the product unnecessary? What kinds of materials were used? What did the materials cost? If expensive materials were used, were they necessary to the success of the design? Does it seem like the manufacturers considered the environment in the design?
5. **Product differentiation:** **Differentiation** is the act of seeing or showing the differences between objects. In the context of industrial design, differentiation is about how a product stands out from other products and how it expresses the company's identity. If you saw an ad for the product, would you remember it or look for it in a store? Does the product make a statement about the company that produces it? Does the product fit in with other products from that company that you are familiar with?

While good industrial design is almost always important, it's especially important for products in a tight market that are competing against many similar products to win the interest of discriminating customers. Take, for example, the portable music player. Think about all the different kinds of music players you've heard about or seen. The companies that make these players are all trying to appeal to an audience that can be very discriminating and particular—an audience that includes you!



<sup>6</sup> From *Product Design and Development* by K. T. Ulrich and S. D. Eppinger. © 2000 The McGraw-Hill Companies, Inc.



Work as part of an Industrial Design team to compare the industrial designs of several portable music players. First, write a brief description of your initial response to the product, paying particular attention to its aesthetic qualities and its user interfaces. Is the product something you'd be interested in buying? Why or why not? Then do a more detailed analysis of each player, assessing its strengths and weaknesses in each of the above categories. Develop a table to organize your analysis.

## DID YOU KNOW?

You aren't likely to see Shiro Kuramata's chairs if you visit the home furnishings area of your local department store—but you may if you visit an art museum! Kuramata, a Japanese artist and designer who worked during the last half of the twentieth century, designed everyday objects, such as chairs and sets of drawers, in a way that focused attention on the form of objects we often take for granted, and transformed them into something new. His pieces move beyond the realm of furniture into that of art.

Kuramata's designs often incorporate innovative materials, such as steel mesh, acrylic, and aluminum, which make the chairs beautiful, if not exactly comfy. For example, one of his chairs, called "How High the Moon," is made entirely of steel mesh. This means that

light can pass through the chair, making it seem ethereal and delicate. It also means that the seat is not very soft! However, the chair's softness—or lack thereof—is not the most important thing about it. Terence Riley, the chief curator of the Museum of Modern Art in New York, said of the chair in an interview with *Newsweek* magazine, "Like all great chairs, it's not very comfortable. . . . There's more to comfort than it being soft on your tush. . . . [The chair] conveys a sense of the here and now."

Another of Kuramata's chairs, "Miss Blanche," was inspired by a corsage worn by Vivien Leigh playing Blanche DuBois in the movie version of *A Streetcar Named Desire*. The chair's body is made of clear acrylic, and red silk roses seem to be floating inside the arms and seat of the chair. While this chair may not be comfortable for sitting, it is a beautiful and evocative work of art.



"Miss Blanche" Chair

## HOMEWORK 4.2

Read **The SC Johnson Administration Building: Form vs. Function** and answer the **Questions for Reflection**.

# The SC Johnson Administration Building: Form vs. Function

One of the most important aspects of design for almost all products is functionality—the product should do what it’s supposed to do, be easy to use, and have relatively trouble-free operation. For example, it won’t matter to most consumers that a stereo is beautiful to look at if the sound quality is poor and the buttons are hard to use. In most cases, good industrial design balances functionality (the user interfaces are easy to understand, the product is ergonomically designed) and aesthetic appeal (the product is pleasing to look at and has a form that is attractive to consumers), which usually go hand in hand.

However, in some instances, the design or form of an object is just as important—or even more important—than its functionality. Moving beyond its original purpose, the object may offer a new way of looking at design as well as at the object itself. For example, think about the clothing that fashion designers present in runway shows. Although technically these garments are functional, in many cases they would be impractical or uncomfortable to wear to work or school, not to mention expensive! However, they do represent the cutting edge of fashion design. They set the trends, and, in some cases, they cause people to think about clothing in new ways.

Although it’s important that most products be designed with functionality foremost in mind, it’s equally important that some designers take risks and produce objects that, while not always entirely practical, challenge how people think about design. Consider the example of the SC Johnson Administration Building. In 1936, the architect Frank Lloyd Wright was asked to design a new



SC Johnson Complex

administration building for SC Johnson in Racine, Wisconsin. The completed building is a masterful and influential piece of architecture, which incorporates many of Wright’s ideas, such as the value of work; the importance of open, airy spaces that flow naturally together; and the use of organic forms. In designing the building, Wright also pioneered the use of new construction materials and techniques, and these innovative elements contribute to the success of the building.

The focal point of the building's interior is the Great Workroom, a large, open space where the company's clerical staff worked when the building was first opened. The workroom is surrounded by a mezzanine, with a penthouse level for executive offices above that. One of the most striking and innovative aspects of the building is the use of what Wright called "dendriform columns," tree-shaped columns with wide, flat plates at their tops, which narrow down to thin columns as they reach the floor. Another prominent feature is the use of skylights and a band of glass tubes between the wall and the ceiling to allow natural light to penetrate the space.



Great Workroom

In many ways, the SC Johnson Administration Building is successful both aesthetically and functionally. In addition to being a powerful piece of architecture, the building is a pleasant space in which to work, and employees who have worked in the space were happy there.

At the same time, though, certain aspects of the building's functionality have been less than successful. Frank Lloyd Wright was always experimenting with new materials and construction techniques. Some of these, such as the dendriform columns, work exactly as designed, while others have had mixed results. For example, Wright used Pyrex tubing to provide the translucent band of light between the walls and the ceiling of the building. These tubes were also used to create skylights. Although the effect of these tubes was quite beautiful, they didn't function well as roofing material. As the tubes expanded and contracted in heat and cold, water worked its way through the caulking, causing the roof to leak. For years, buckets were kept in the Great Workroom to catch all the water when it rained! Eventually, the tubes in the ceiling had to be replaced with ribbed sheets of plastic that replicated the look of the tubes. Also, the band of tubes between the ceiling and wall unexpectedly caused a glare in some parts of the building, and blinds had to be installed over them.

In addition, the Administration Building and the accompanying Research Tower that Wright eventually designed have had some maintenance challenges over the years—the inevitable result of experimental materials and techniques. In fact, many of Wright's buildings have had problems, such as leaky roofs and rooms that were too hot or too cold. For many of the owners of these buildings, though, such inconveniences seem a small price to pay for the privilege of living or working in such beautiful places. In some ways, what's important about Wright's buildings, at least as much as their functionality, is their ability to open people's eyes to the possibilities of human-made spaces.

## Questions for Reflection

1. Do you agree that it's acceptable for form or design to take precedence over function in some instances? Why or why not?
2. Based on the information in the reading, assess the industrial design of the SC Johnson Administration Building, using the five criteria listed in Seeking Good Design on page 60. Do you think the building has a good industrial design?
3. Can you think of objects you have seen whose design is more important than their functionality?

## A BETTER PLAYER

Now that you've seen some examples of industrial design, how would you design a product? Look at your analyses of portable music players. Are there areas in need of improvement? Would you like a player that was bigger or smaller, or just looked different? Would you reconfigure the buttons or change the display?



With your Industrial Design team, develop a new industrial design for a portable music player. Be sure to consider both how the player looks and how users will interact with the product. Sketch your player on drafting paper, labeling all of the important features that distinguish your design from the original product.

### HOMEWORK 4.3



Think about the product you're working on for your Redesign Proposal project and generate some industrial design ideas that you might incorporate into your product redesign.

## APPLYING GOOD DESIGN



Share your industrial design ideas from Homework 4.3 with your Redesign team and begin developing an industrial design for your product. To get started, consider the industrial design of similar products and think about how these designs could be improved upon. You might also consider incorporating elements of design from other products that you like. Your industrial design should take into account the following:

1. **Quality of user interfaces:** How will customers use the product? Will it be easy to understand? Comfortable to use? Accessible for people with disabilities?
2. **Emotional appeal:** How will your product look? How will it feel to touch? What image will the product convey to customers?
3. **Ease of maintenance and repair:** Does the product require any assembly or maintenance, such as replacing batteries? Will these operations be easy for the average user to perform?
4. **Appropriate use of resources:** What are the main features of the product? Will it have any “bells and whistles” that customers might not necessarily want or need? What materials will you use? Are these materials expensive? If so, are they necessary? Will use of the materials have adverse environmental impacts?
5. **Product differentiation:** How will your product stand out from similar products in the marketplace? What kind of statement does your industrial design make about your product?

Once your Redesign team has decided on an industrial design for the product, create several sketches of it, labeling the important features.

### HOMEWORK 4.4



Continue to work on the industrial design of your Redesign Proposal project.

## HOMework 4.5



Continue to work on your assigned tasks for the Redesign Proposal project.

## EXTENSIONS

### 4.1

Create a Web site or Microsoft® PowerPoint® presentation that shows some examples of good and bad industrial designs, as determined by you or by product reviewers, and that identifies the design features that make each product successful or unsuccessful.

### 4.2

Research the requirements for starting a job as an industrial designer, and look for college programs and internships that would prepare you for such a position.

### 4.3

Using a CAD program, draw the product that you are redesigning for your Redesign Proposal project. Then use the CAD program to help you develop your industrial design ideas. Pay special attention to aesthetics and user interfaces.





## ACTIVITY 5: Putting It On Paper

### INTRODUCTION

Have you ever tried to describe how to put together or use an object to someone else, and the person just didn't seem to know what you were talking about? How did you clear up the confusion? Knowing how to communicate information about a product to different audiences is an essential part of the design process. Product designers need to communicate ideas to many different audiences, including customers, engineers, colleagues, and other company divisions. They might present a technical illustration to an engineer who will develop the product concept further, but present a descriptive paragraph and attractive drawings of the product to a potential customer. In this activity, you'll learn how designers reach different audiences through descriptive writing, technical drawings and illustrations, and advertisements.

### Learning Goals

- › Create a technical drawing of a product to scale.
- › Create visual representations of a product that are appropriate for specific audiences.

### FOR YOUR GLOSSARY

**Design patent**

**Dimension lines**

**Intellectual property**

**Orthographic drawings**

**Patent**

**Technical drawing**

**Utility patent**



## WHAT'S IN A DRAWING?

When a written description isn't enough, what should you do? In Module 10, *Reverse Engineering*, you worked with a specific type of technical illustration: assembly drawings. While these are helpful for depicting a product in an owner's manual or showing the product to a manager in your company, this type of illustration does not provide enough information about a product's dimensions, materials, and structural components for some audiences, such as the technicians and engineers who will help manufacture the product. These audiences need specific technical information with enough details to clearly convey design ideas.

If you are trying to convey information about your product to manufacturers or engineers, you will need to create a **technical drawing**—a scale representation of a product or one of its components that includes the multiple views required to describe it accurately. These views usually include a front view, a top view, and a side view. Technical drawing is the language of engineers, designers, and architects, who use it to communicate design ideas in as much detail as possible to the people who may be involved in manufacturing the product, such as manufacturing or mechanical engineers.

### LABELING TECHNICAL DRAWINGS

The lettering on a technical drawing is extremely important—it enables the engineer, architect, or designer to communicate a complete description of an object to the person who will make the object and to the client who will buy it. Block letters (all caps) are used as the standard style of lettering for engineering and architectural drawings. While computer-aided design (CAD) systems have decreased the importance of lettering skills, engineers, designers, and architects still need to be able to complete freehand sketches with hand lettering to communicate with drafters and CAD operators.

**THIS IS AN EXAMPLE OF THE LETTERING THAT IS USED IN TECHNICAL DRAWINGS.**

Study the examples of technical drawings and illustrations shown in **Sample Drawings and Illustrations** and do the following:

1. Compare and contrast the information provided by each drawing.
2. Indicate which of the drawings could be used as a guide for manufacturing the object.
3. Indicate which of the drawings would be best to include in an owner's manual, and which would be best in a repair manual.

## HOMWORK 5.1

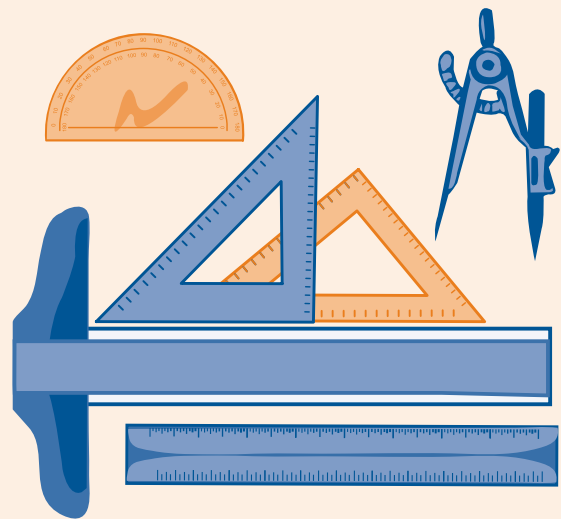
Read **Technical Drawings: Methods to Display Shape and Size**. Choose one ordinary object from home and create an orthographic drawing of it. Then add the dimensions for each view. Refer to the reading and your classwork to complete the drawing.

# Technical Drawings: Methods to Display Shape and Size

Creating technical drawings involves using particular tools and techniques. For example, when creating a freehand sketch of an object, it's important to always use grid paper. This will help you make sure that your scale is correct. A medium-weight lead or drawing pencil with a rounded point works best for making freehand sketches.

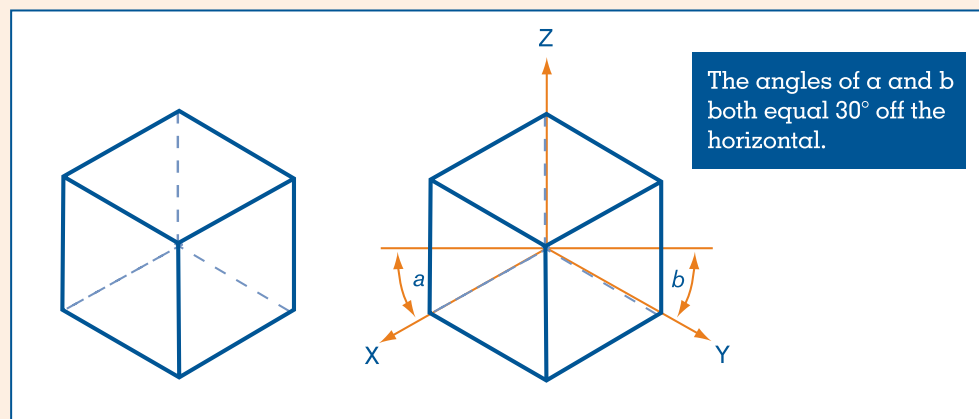
These are the basic tools for technical drawing:

- A T-square, used for drawing horizontal lines
- Triangles (both a  $45^\circ$  and a  $30/60^\circ$ ), used to draw vertical and angled lines when placed on the T-square
- A protractor, used to measure angles
- A ruler, used to make proportional drawings at greater or reduced sizes
- A compass, used for drawing arcs and circles



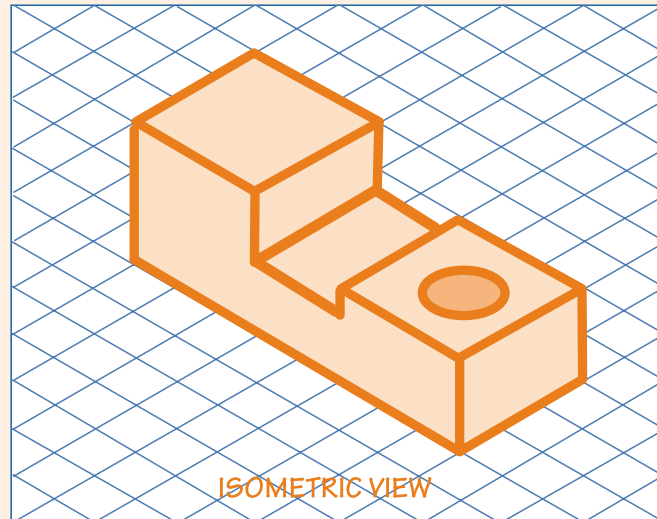
## Isometric Drawings—Giving a Three-Dimensional View

An isometric drawing shows many sides of the same object; the top, front, and side views are equally visible. The purpose of an isometric drawing is to give people a realistic view of the object. The following figure shows the angles used to draw an isometric figure:



Isometric grid paper makes it easier to figure out the angles and draw an object in 3-D. **Figure 5.1** is an isometric drawing of Widget XYZ on isometric grid paper.

**Figure 5.1: Widget XYZ on Isometric Grid Paper**

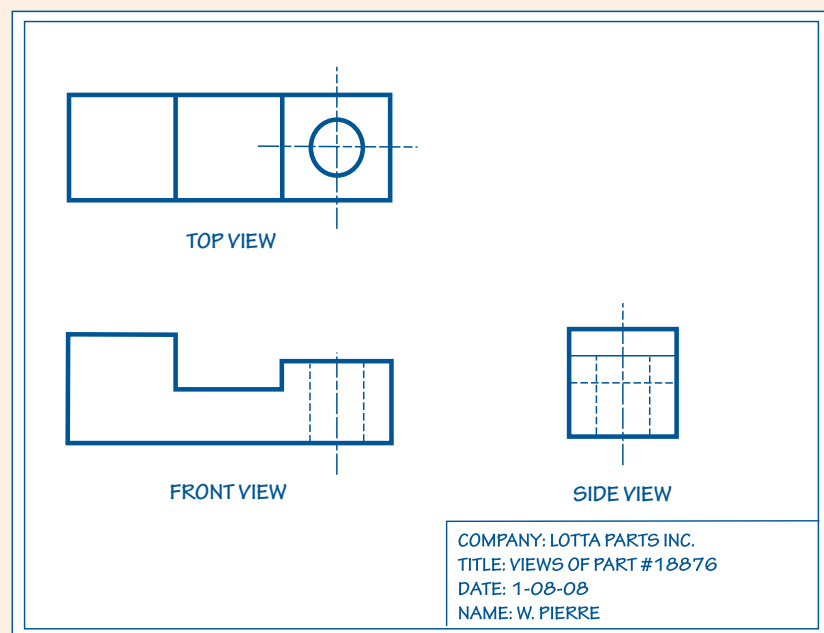


## Orthographic Drawings—Showing the Shape of an Object

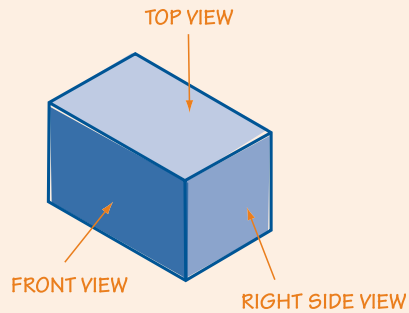
**Orthographic drawings** present usually three, but as many as six, different views of an object, all at right angles to one another.

**Figure 5.2** is an example of an orthographic drawing. Notice that the angle between the top, front, and side views of the object is 90 degrees (a right angle)—just like the actual sides of the widget.

**Figure 5.2: Widget XYZ**



Imagine drawing a child's wooden block. Look at it from the top—this is the block's "top view." Looking at the front face of the block gives you its "front view." Turning the block to the right gives you its "side view."



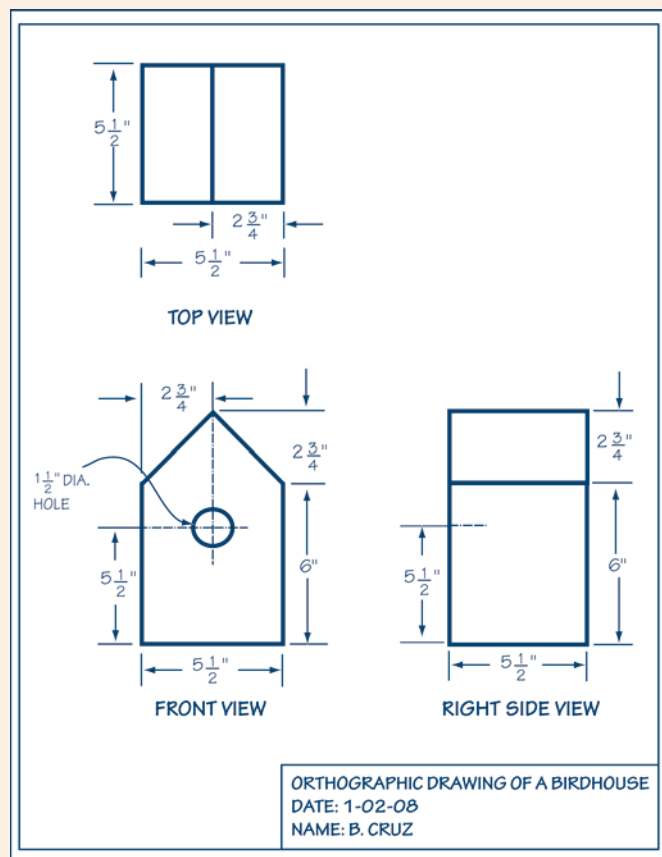
When making an orthographic drawing, remember the following general guidelines:

1. Position the top view above the front view so that the lengths of each view line up.
2. Position the right side view to the right of the front view so that the heights line up.

## Dimensions—Showing the Size of an Object

Illustrations or sketches often show an idealized view of an object. While illustrations are effective tools for showing the general look of an object, a technical drawing needs to give enough information to convey its actual shape and dimensions. **Figure 5.3** shows how the dimensions of a birdhouse are conveyed in the multiple views shown in a technical drawing.

**Figure 5.3: Orthographic Drawing of a Birdhouse**

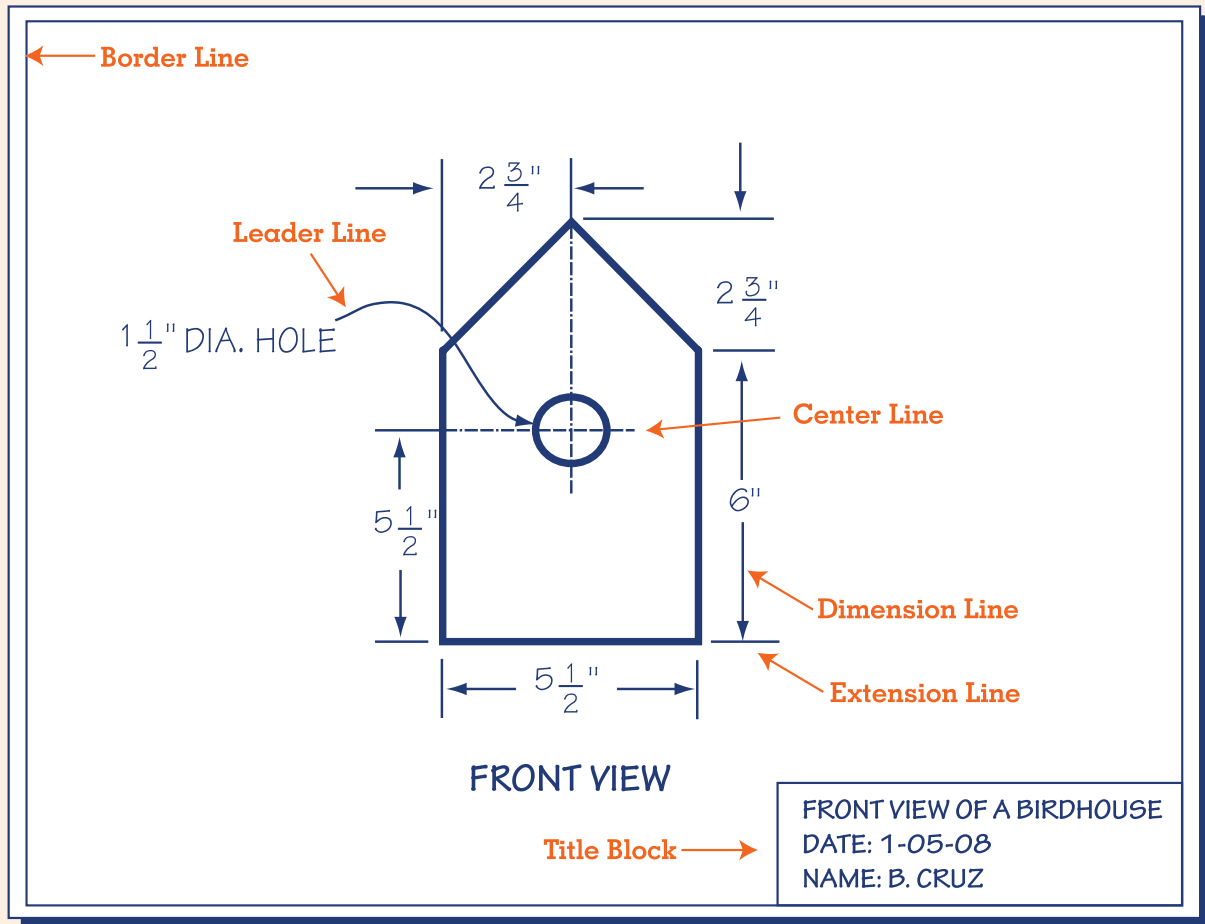


## Guidelines for Drawing an Object

Use the following guidelines to construct a basic orthographic drawing with **dimension lines** (lines to display the length of the side of an object or the locations of particular features, such as holes and notches; these lines run parallel to the object, include arrows at both ends, and have a blank space in the middle for the numerical value of the length):

1. Study the object and determine the views (front, back, top, left side, or right side) that will be needed to completely describe the object. If any sides are identical, you may not need to repeat those views.
2. Determine a scale that matches your paper. Most grid paper displays a  $\frac{1}{4}$  or  $\frac{1}{8}$ -inch grid. Measure your object (if you are drawing a real object) and choose the actual length that will correspond to  $\frac{1}{4}$  or  $\frac{1}{8}$  inch on your paper. For example, a 1-inch measurement of the actual object may be represented by  $\frac{1}{4}$  inch on your graph paper. Also, be sure to choose a scale that makes efficient use of your paper—fill the page and show the object clearly. You don't want to choose a scale so small that your drawing only uses a tiny portion of the page!
3. Using a ruler and any other technical drawing tools you have available, draw each view on your grid paper.
4. For each view, include dimension lines to display the length of the side or the location of particular features, such as holes and notches. Dimension lines showing specific features should be drawn first, closest to the object, with dimension lines showing the total length of the sides outside the feature dimension lines. **Figure 5.4** provides an example.
5. Indicate the ends of dimension lines with extension lines—short solid lines drawn outward from the side of an object. These lines should not touch the views to which they refer, unless they connect to a center line. Orient your dimension numbers horizontally so they can be read without rotating the page.
6. Include leader lines if necessary to indicate details about specific features of the object, such as a hole. Leaders are freehand lines with at least one wave or curve and an arrowhead.
7. Technical drawings have standard sizes of 8.5" x 11", 11" x 17", 17" x 22", 22" x 34", and 34" x 44" (all multiples of 8.5 x 11). A border line should be drawn  $\frac{1}{2}$  inch from the paper's edge around the drawing.
8. Include a title block listing the name and a description of the drawing, the name of the person who drew it, the scale, and the date.

Figure 5.4: Border, Center, Dimension, Extension, and Leader Lines





## HOW GOOD A DESCRIPTION?

Share the technical drawing you completed for Homework 5.1, and look at the other students' drawings. For each drawing you look at, answer the following:

1. Do you recognize the object you are looking at? What is it?
2. Does the drawing include all the necessary labels and dimension information?
3. Whom do you think this drawing would be useful to?

## WHO HAS THE RIGHTS?

For an inventor or product developer, one of the most important ways to use a technical illustration is in a patent application. A **patent** protects designs and inventions by giving the patent holder the exclusive right to make, use, import, and sell an invention within a country (or group of countries) for a specified number of years. Without patents, all the hard work that design teams put into creating new products could benefit other companies that would be allowed to simply make copies of their designs. Patents protect one kind of **intellectual property**, which is a unique product of the human mind; in addition to designs and inventions, intellectual property also includes books, movies, and music.

In order to be granted a patent in the United States, a company or individual must apply to the U.S. Patent and Trademark Office. Illustrations are often an important part of the patent application. Patent applications have to clearly explain what the item is, how it works, and how it is made. Since photographs of the invention or design are allowed only under certain circumstances, technical illustrations are usually used in patent applications.

Look at the products in **Patent Illustrations** and answer the following:

1. What is the product shown in each illustration?
2. What details about the product are presented in each illustration?
3. What aspect of each product do you think the applicants are trying to patent?

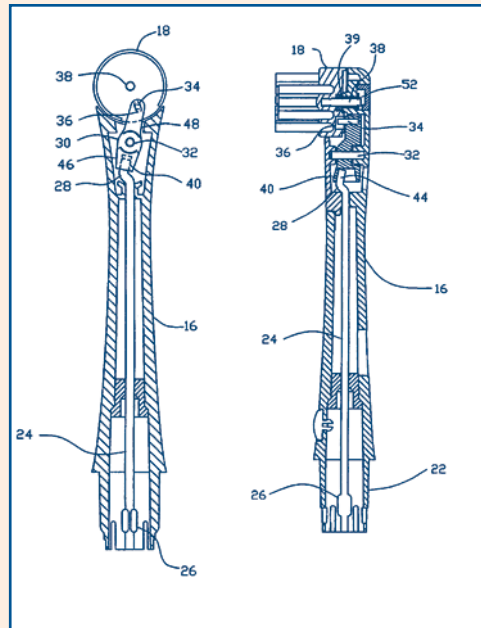
### HOMEWORK 5.2

Read **Patents**.

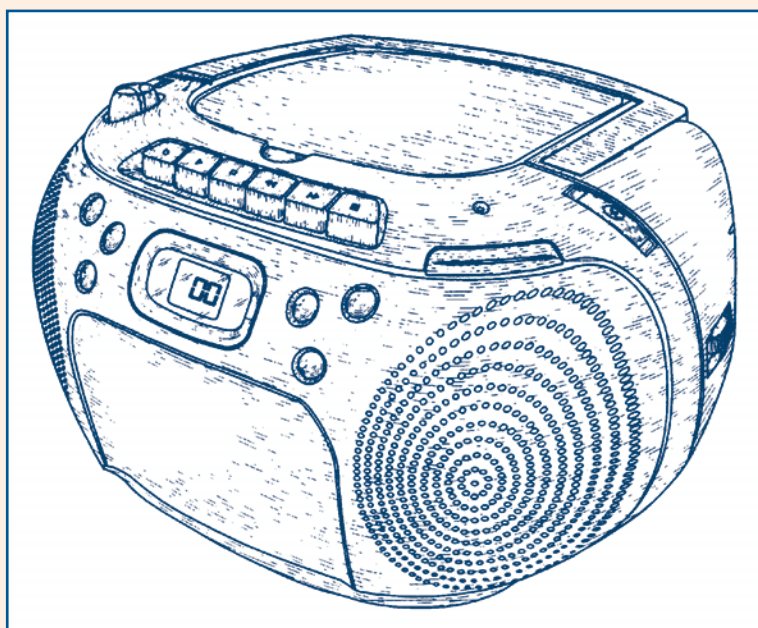
# Patent Illustrations

Patent illustrations show the details of the aspect of an invention being patented. Major elements of this aspect are shown and, in some cases, numbered. (If they're numbered, a key describing each numbered part should be included in the application.)

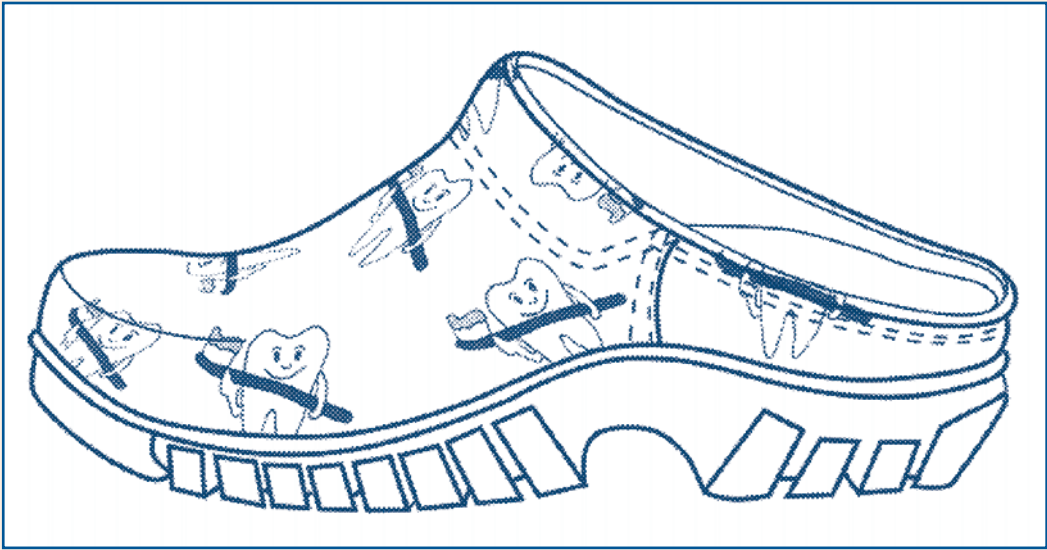
## Example 1



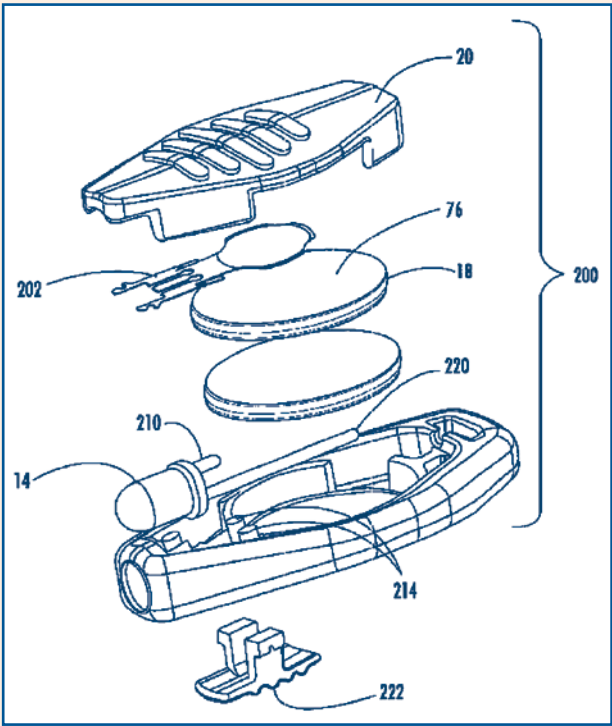
## Example 2



Example 3



Example 4



# Patents

## What Is a Patent?

A patent is a grant of property rights that is given to an inventor. In the United States, patents are granted by the U.S. Patent and Trademark Office (USPTO). There are several different kinds of patents. A **utility patent** protects processes, machines, products, materials, or improvements to any of these things. For example, an inventor may apply for a utility patent to cover a new kind of speaker. A **design patent** protects new decorative designs. For example, a designer may apply for a design patent to cover a new shoe design—not the material or construction of the shoe, but the way that the shoe looks. There are also separate plant patents that cover certain kinds of genetically altered plants. Patents usually last for 20 years from the date when the application is filed with the USPTO.

## Why Get a Patent?

Without a patent, inventors would have no way to keep others from producing copies of their inventions and selling the copies. There would be no incentive to develop new products and processes if others could immediately begin to profit from an inventor's work. However, there are some circumstances in which it may be better not to get a patent. If a company doesn't want its competitors to have access to information about a product, it may make information about the product or process a trade secret (since a patent would make the information public). Companies maintain trade secrets by giving a limited number of people access to the information and making those who do have access sign contracts stating that they won't reveal what they know. One of the most famous examples of a trade secret is the formula for Coca-Cola®.

## What Information Do You Need for a Patent Application?

A patent application must include a detailed description of the invention or design. If the application is for a utility patent, it must also explain how the invention is used and made (or how the process is carried out). The application usually contains detailed black-and-white drawings of the invention or design. In order for a patent to be granted, the USPTO must determine that the invention or design is both new and useful. Because applying for a patent can be a complex process, many inventors and designers work with patent attorneys who specialize in preparing these applications.

## The Role of Illustrations in a Patent Application

A patent application may include many different kinds of technical illustrations, depending on the invention or design. (However, some patent applications, such as those for certain processes, may not have illustrations at all.) Design patent illustrations may be fairly simple, showing just the external design of a product, such as

the stereo and shoe (Examples 2 and 3) in **Patent Illustrations**. Some utility patents may include “exploded assembly” drawings, such as Example 4 in **Patent Illustrations**. Others may include detailed labeled diagrams, as in Example 1 in **Patent Illustrations**, where the major elements of the invention are shown and numbered, and a key describing the numbered parts would be included with the illustration.

## SEARCH THE DATABASE

The USPTO Web site contains a database of all the patents issued in the United States, dating back to 1790! There are a variety of ways to search the database, and it can be confusing at first—a little practice is needed.

Go to the **Ford PAS Web site** to link to the USPTO Web site and perform a “quick search,” which allows you to choose the type of information you want to search for.



For example:

- Patent title
- Abstract—a brief written description of the invention
- Patent issue date
- Patent number
- Inventor name
- Inventor state

First, look at a few of the applications. Then search the patent titles for any title containing the name of the product that you are redesigning. (For example, if you were redesigning a broom, you would search the titles for “broom.”) If you are redesigning a specific aspect of a product, you could search for just that aspect (for example, “broom handle”). Browse the patents to see if anyone has designed a concept similar to yours.



Choose two or three of the patents most closely related to your Redesign Proposal project and summarize them, including the following information:

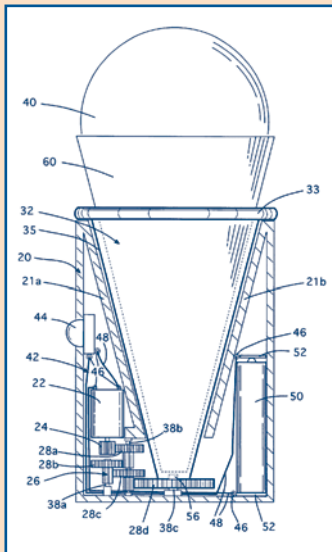
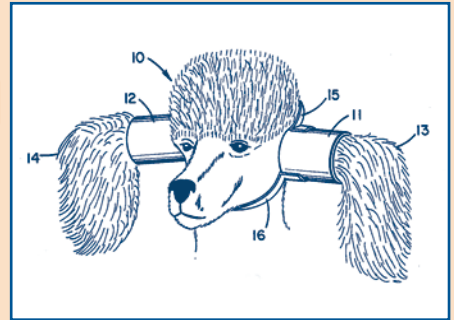
1. The patent number and date of issue
2. The inventor
3. A sentence or two that describes the invention
4. A list of the features that distinguish each of these inventions from one another and from your redesign concept

For each patent that you summarize, be sure to view the accompanying images and note features of both the written and the illustrated descriptions of the object.

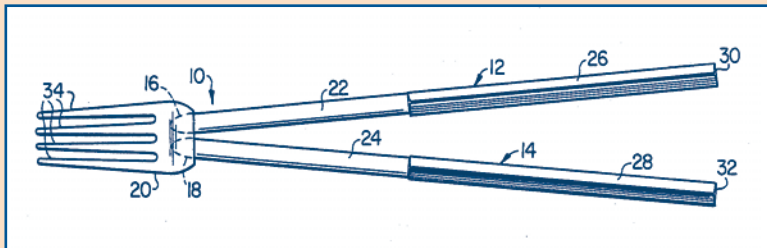
## DID YOU KNOW?

Many new product ideas are patented each year, but not all of them make it into the hands of consumers. Here are some products that you probably won't see on a store shelf any time soon:

- U.S. Patent 4,233,942: In 1980, William D. James was granted a patent on a device to protect an animal's ears (especially the ears of long-haired dogs) while it is eating. A tube holds each ear away from the animal's head, and the tubes can be adjusted to keep the ears away from food or water dishes.



- U.S. Patent 5,971,829: In 1999, Richard B. Hartman was granted a patent for a motorized ice cream cone. The device comes in two versions: One consists of a motorized, rotating cup into which a scoop of ice cream can be placed, and the other consists of a motorized, rotating receptacle into which an entire ice cream cone can be placed. People eating ice cream out of this device could hold their tongues stationary against the ice cream, instead of licking.
- U.S. Patent 4,809,435: In 1989, Gerald L. Printz was granted a patent for a new kind of utensil. The end of the utensil to be grasped in the hand has two separate handles, resembling chopsticks. However, these chopstick-like handles are attached to a western-style utensil, such as a fork or spoon. In this way, a person can have an experience similar to that of using chopsticks without actually having to learn how to use them.



## HOMEWORK 5.3



Read **Reaching Customers Through Print Ads** and generate ideas for a print ad for your Redesign Proposal product.



# Reaching Customers Through Print Ads

One of the many ways that companies introduce new or redesigned products to their customers is through print ads. Print ads appear in magazines, in newspapers, or on billboards. There are many different kinds of print ads—some of which don't even feature the product. However, one kind of ad that is especially useful for introducing potential customers to a new product is one that shows people actually using the product. This kind of ad allows companies to demonstrate the features of the products while showing happy customers at the same time.

Look at the following ad, which shows three different people using a trash can:



**EZ Trash Can-**  
For easy clean up and disposal with just a tap of your foot!

Here is what this ad intends to communicate to potential customers:

- **Product features:** The ad clearly shows that the trash can has a large capacity and a lid that opens easily when you step on a pedal at its base.

- **Ease of use:** The ad shows that it's easy to dispose of trash even when your hands are full, take out a full trash bag by pulling out the inner can, and put in a new bag. This is reinforced by the text accompanying the ad ("easy" and "just a tap of your foot").
- **Customer satisfaction:** The people in the ad are smiling; they seem pleased with how well the trash can is functioning and how easy it is to use.
- **Product image:** The people in the ad are young and contemporary, the garbage can has a sleek metallic design, and the accompanying text is in a modern font. The ad is meant to appeal to young hip people who have busy lives.

As you develop an ad for your own redesigned product, think about what you want to convey to customers regarding your product's features and image, its ease of use, and customer satisfaction with your product.

## ADVERTISING YOUR REDESIGN



Imagine that your Redesign team is developing a print ad to introduce your redesigned product to customers. How would you convince customers that your product concept is a good one? Create a print ad for your product that shows some of the product's features and the image you're trying to convey with the product. Use the list of ideas you generated for Homework 5.3 as a starting point.

### HOMEWORK 5.4



Continue to work on your print ad for the Redesign Proposal project.

## DRAWING YOUR PRODUCT



Although some audiences may prefer less-detailed images of your product, others will want to see the exact product specifications.

Working with your Redesign team, choose one of the following options:

1. Prepare a technical illustration that could be included as part of a patent application for your product concept.
2. Prepare an orthographic drawing that shows the dimensions of each view of the product to show to a manufacturing engineer.

Once you've chosen an option, have each member of your Redesign team make a technical illustration or orthographic drawing of your product. Select the best one to include with your final redesign proposal.

### MATERIAL AND USAGE SPECIFICATIONS

Before a designer is ready to meet with a manufacturing engineer, he or she needs more information than just what is included in a dimensioned drawing. The designer needs to have determined the material specifications (what materials will be needed), based on the usage specifications of a product (how it will be used). For example, if a manufacturing engineer were presented with a dimensioned drawing of a birdhouse, the engineer's first question would be, "Is this birdhouse going to be made from wood, metal, plastic, or glass?" In order for the designer to answer that question and provide the engineer with the proper specifications for the birdhouse, the designer would need to have answers to some of the following questions (which address both materials and usage):

1. Will the birdhouse be used for decorative indoor use or functional outdoor use?
2. Will the birdhouse be expected to withstand usage for 1 year or 10 years?
3. Given the amount of money that the company wants to spend on total production costs for each birdhouse, how much can the birdhouse materials cost?
4. What materials are readily available?
5. Will the birdhouse be delivered as a finished product or as a kit that the customer assembles? (The answer to this question will affect assembly cost, packaging method and cost, and shipping cost.)
6. Will any testing or quality inspections be done before the final product is shipped?

## HOMWORK 5.5



Continue to work on your Redesign Proposal project.

## EXTENSIONS

### 5.1

Prepare a freehand, orthographic drawing of a large object, such as a building or vehicle. Have your teacher, a classmate, or someone employed in architecture or a design field give you feedback on the sketch. Revise your sketch with this feedback in mind.

### 5.2

Create a 3-D version of your redesigned product by building a scale model.

### 5.3

Use a CAD program to draw your redesigned product and create drawings from different views. What new information does each view provide to the person drawing or to the audience?

### 5.4

Use a CAD program to make an orthographic drawing of your product and include the product's measurements.





## ACTIVITY 6: Putting It All Together

### INTRODUCTION

In this activity, you'll have a chance to present the redesigned product you've been developing throughout the module and see the products that your classmates have redesigned.

### Learning Goals

- › Create a redesign proposal for a product.
- › Design and deliver an effective presentation of a product redesign proposal, including visual representations.

### FOR YOUR GLOSSARY

**There are no glossary words for this activity.**

## REDESIGN PROPOSAL PREPARATION

Working with your Redesign team, prepare a presentation showcasing your redesigned product. Your presentation should not exceed five minutes, so choose the information to include carefully!

### DID YOU KNOW?

Although many new or redesigned products are developed by companies and entrepreneurs, there are also other ways in which these products come into existence. For example, some organizations within the government focus on research and development, which can lead to products that eventually find their way into the marketplace.

One such group is the Processed Foods unit at the Western Regional Research Center of the Agricultural Research Service, the USDA's research arm. This group, led by Tara McHugh, Ph.D., has researched the use of fruit and vegetable purees in new products and has developed an edible film that could someday replace the plastic wrap you use to wrap up your sandwich! The wraps would come in such flavors as strawberry, apple, broccoli, and carrot. Once used, they could be microwaved or heated with the food they covered, adding some flavor and extra nutrition to the meal. Because the film is completely edible and biodegradable, its use could keep some waste out of the environment. The wraps could also help people increase their intake of fruits and vegetables. The wraps were honored with a "Best of What's New" award in *Popular Science* magazine in 2001.

Although as of 2004 the wraps were still being researched, they could be on the market someday. A fruit bar made of pear puree developed by McHugh and her colleagues is already being manufactured and sold by a company in the Pacific Northwest, which licensed the process for making the bar from the USDA. To find out more about this product, visit the **Ford PAS Web site**.



### HOMEWORK 6.1



Prepare for your Redesign  
Proposal presentation.



## REDESIGN PROPOSAL PRESENTATIONS



Present your redesign proposal. As you listen to other Redesign teams' presentations, assess their proposals using the **Redesign Proposal Presentation Peer Assessment**. Use the **Presentation Skills Assessment** to assess your own presentation.

### HOMEWORK 6.2

Prepare for the **Module Test**.

## EXTENSION

### 6.1

Conduct research to find a new or redesigned product that has recently come onto the market or will be coming onto the market in the next year. Develop a presentation or report about the product that showcases features of the product's design, your analysis of the design, and the reasons that you think (or don't think) the product will be successful.





# For Further Reading

## Activity 1

### Product Design

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Interiors and Sources. (n.d.). *ISdesignNet* magazine. Retrieved April 30, 2003, from [www.isdesignnet.com/index.html](http://www.isdesignnet.com/index.html).

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### Universal Design

Center for Universal Design. (2002–2003). *Universal design education online resources*. Retrieved April 30, 2003, from [www.udeducation.org/res\\_mat/index.asp](http://www.udeducation.org/res_mat/index.asp).

## Activity 4

### Industrial Design

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LaSalle, S., & Britton, T. A. (2003). *Priceless: Turning ordinary products into extraordinary experiences*. Boston: Harvard Business School Press.

## User Interfaces

Norman, D. A. (2002). *The design of everyday things*. New York: Basic Books.

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## Activity 5

### Graphic Rendering

Ching, F. D. K. (1997). *Design drawing*. New York: John Wiley & Sons.

Lin, M. W. (1997). *Drawing and designing with confidence: A step-by-step guide*. New York: John Wiley & Sons.

### Technical Drawing

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Mace, R., Hardie, G., & Plaice, J. (1991). Accessible environments: Toward universal design. In Preiser, Vischer, and White (Eds.), *Design interventions: Toward a more humane architecture* (p. 156). New York: Van Nostrand Reinhold, as quoted in Welch, P. (Ed.). (1995). Chapter 1: Adaptive environments center and MIG communications. *Strategies for teaching universal design*. Retrieved May 14, 2003, from [www.adaptenv.org/universal/pdf/strategies1.pdf](http://www.adaptenv.org/universal/pdf/strategies1.pdf).

Universal Design Education Online Web Site. (2002–2003). *Learning about universal design*. Center for Universal Design. Raleigh, NC: North Carolina State University. Retrieved May 14, 2003, from [www.udeducation.org/learn/index.asp](http://www.udeducation.org/learn/index.asp).

### Listening to Customer Needs

Kelley, T. (2001). *The art of innovation: Lessons in creativity from IDEO, America's leading design firm*. New York: Currency Books.

### Product Need Statements

Ulrich, K. T., & Eppinger, S. D. (2000). Exhibit 4-7. *Product design and development* (2nd ed.), p. 70. Boston: Irwin McGraw-Hill.

## The Art of Idea Generation

Garmston, R., & Wellman, B. (1999). *The adaptive school: A sourcebook for developing collaborative groups*. Norwood, MA: Christopher-Gordon.

Kelley, T. (2001). *The art of innovation: Lessons from IDEO, America's leading design firm*. New York: Currency Books.

## Getting Customer Feedback

Kelley, T. (2001). *The art of innovation: Lessons in creativity from IDEO, America's leading design firm*. New York: Currency Books.

Ulrich, K. T., & Eppinger, S. D. (2000). *Product design and development* (2nd ed.), pp. 63, 66. Boston: Irwin McGraw-Hill.

## Activity 2

### Knowing the Competition

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### A Designer's Concept

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Bowerman, B., & Knight, P. (May, 1997). *The modern athletic shoe*. Retrieved April 23, 2003, from [web.mit.edu/invent/iow/bowermanknight.html](http://web.mit.edu/invent/iow/bowermanknight.html).

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National Distance Running Hall of Fame. (2003). *Bill Bowerman*. Retrieved February 11, 2004, from [www.distancerunning.com/inductees/2002/bowerman.html](http://www.distancerunning.com/inductees/2002/bowerman.html).

Ransdell, E. (January, 2000). The Nike story? Just tell it! *Fast Company* (31), 44. Retrieved February 11, 2004, from [pf.fastcompany.com/magazine/31/nike.html](http://pf.fastcompany.com/magazine/31/nike.html).

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Yemma, J. (1998). The bionic lobster. *Boston Globe*. Retrieved February 11, 2004, from [cache.ucr.edu/~currie/lobster.html](http://cache.ucr.edu/~currie/lobster.html).

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### Choosing a Concept

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### Manny's Batting Gloves

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Segway. (2001–2003). *Segway™ HT i Series*. Retrieved September 18, 2003, from [www.segway.com/segway/specs\\_iseries.html](http://www.segway.com/segway/specs_iseries.html).

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### What Is Industrial Design?

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Ulrich, K. T., & Eppinger, S. D. (2000). *Product design and development* (2nd ed.). Boston: Irwin McGraw-Hill.

### Seeking Good Design

Ulrich, K. T., & Eppinger, S. D. (2000). *Product design and development* (2nd ed.), pp. 227–230. Boston: Irwin McGraw-Hill.

## Did You Know?

*Exhibition: Overview: Shiro Kuramata: 1934–1991.* (n.d.). Retrieved January 10, 2003, from [www.sfmoma.org/exhibitions/exhib\\_detail/97\\_exhib\\_shiro\\_kuramata.html](http://www.sfmoma.org/exhibitions/exhib_detail/97_exhib_shiro_kuramata.html).

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Twombly, R. C. (1979). *Frank Lloyd Wright: His life and his architecture*. New York: John Wiley & Sons.

## Activity 5

### What's in a Drawing?

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### Labeling Technical Drawings

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## Technical Drawings: Methods to Display Shape and Size

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TEKit. (n.d.). *Orthographic views/Isometric views*. Retrieved October 31, 2003, from [www.foothillsgraphics.com/iso.htm](http://www.foothillsgraphics.com/iso.htm).

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